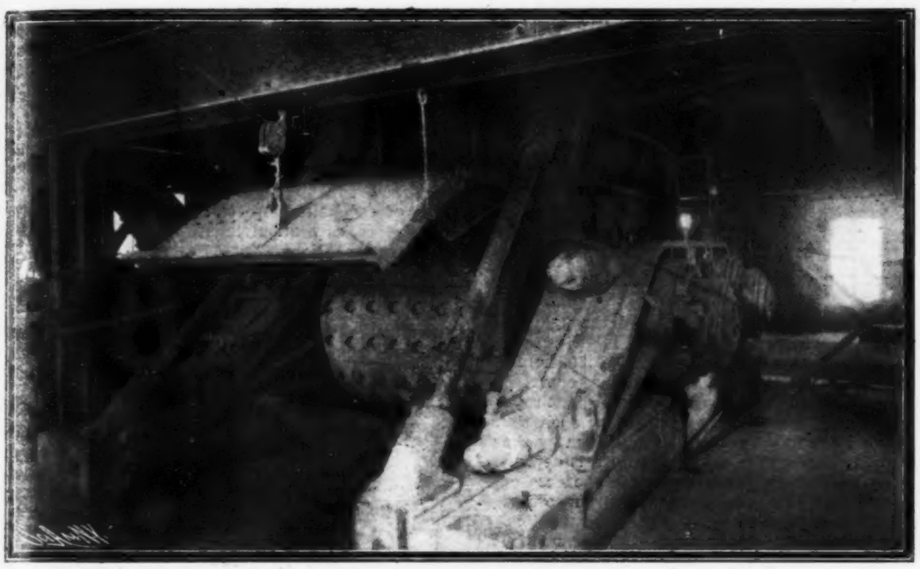
SCIENTIFIC AMERICAN SUPPLEMENT. No. 1465

Entered at the Post Office of New York, N. Y., as Second Class Matter. Copyright, 1904, by Munn & Co.

Scientific American, established 1845.
Scientific American Supplement, Vol. LVII. No. 1465.

NEW YORK, JANUARY 30, 1904.

Scientific American Supplement $5 a year.
Scientific American and Supplement $7 a year.

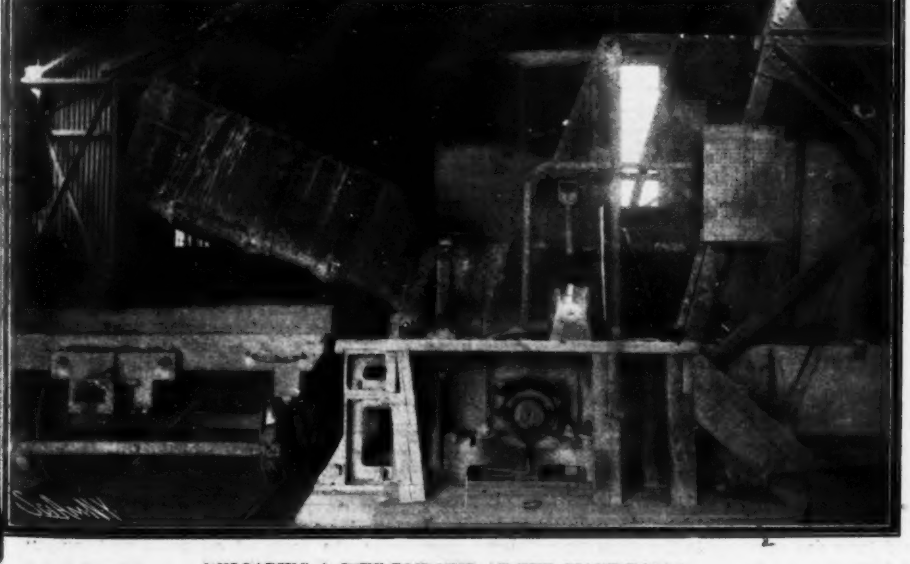


THE GIANT ROLLS WHICH ARE CAPABLE OF CRUSHING FIVE-TON BLOCKS OF STONE.

THE MAIN TUNNEL.

CHALK STOCK HOUSE AND ITS SCREW CONVEYER.

THE ONE-HUNDRED-AND-FIFTY-FOOT ROTARY KILNS.



UNLOADING A FIVE-TON SKIP AT THE GIANT ROLLS.

INTERIOR OF THE CLINKER STOCK HOUSE.

THE EDISON PORTLAND CEMENT WORKS.

THE EDISON PORTLAND CEMENT WORKS.

READERS of the SCIENTIFIC AMERICAN will doubtless remember the magnetic ore-concentrating plant which Mr. Thomas A. Edison designed a few years ago, for the purpose of commercially utilizing low-grade ores which could not be profitably reduced by the ordinary methods. An outcome of the many experiments made at that plant is Mr. Edison's method of manufacturing Portland cement—a method which is all the more interesting because it is so radically new in its processes and in the machinery which it employs. Giant rock-crushers, similar to those used in the ore-concentrating plant referred to, are employed in crushing stones as large as five tons. Sieves with a mesh of 200 are employed in a grinding mill which has an output of 280 barrels an hour. The fine is ingeniously separated from the coarse ground material by an air blast; and rotary kilns, 150 feet long and 9 feet in diameter, burn the raw material. These are but a few of the novel features to be found in the machinery of this remarkable plant. The works have been designed for the purpose of transferring material from building to building with the utmost dispatch and convenience. The structures are divided into groups, each devoted to one process of manufacture, all being supplied from a main electrical and mechanical station.

The plant itself consists essentially of six groups of buildings, the first being devoted to crushing, the second to weighing and mixing the raw material, the third to grinding, the fourth to burning or calcining, the fifth to clinker grinding and cement storing, and the sixth to coal pulverizing. The first two groups have been designed for the full capacity of the works, which is about 10,000 barrels per day. The present capacity of the remaining structures is about 5,000 barrels.

Limestone and cement rock are found close together. The cuts are 50 to 70 feet deep. The rock is loosened largely by blasting, although much of it is soft enough to be cut out by the steam shovel. In order to avoid the difficulties due to snow and ice during the winter months, a removable roof, supported by steel trusses, is used over the quarry cuts. Whenever a heavy blast is to be made, the roof is rolled out of danger.

The rock is deposited into skips on the flat cars, trains of which are hauled to the works by a steam locomotive. An open shed spans the track and is long enough to shelter about twenty cars at one time during the winter months. After the flat cars have reached the works, they are hauled, three at a time, to the crusher house, where an electrically operated hoist lifts the skips individually, and dumps their contents into the hopper of the giant crushing rolls. These rolls are mounted in four sets in the crushing mill, and are placed one above the other, so that the passage of the material through them is downward by gravity. The rock from the quarry must thus be hauled to a point above the highest pair of crushing rolls. For that reason, there is an incline some 260 feet long extending to a floor about 50 feet above the ground, up which incline the cars are hauled by an electrical hoist. By means of a large rheostat controller the operator of the hoisting motor is able to bring each skip in succession opposite the mouth of the hopper above the main crushing roll. Each skip is placed sidewise on its car. By means of another motor, the operator lifts the skip, dumps the rock into the hopper, and returns the skip to the car, whereupon the next car is brought into position. The empty cars drop down the incline by gravity and are run back to the quarry. Another train of three loaded cars is by this time on its way.

The first pair of crushing rolls are 5 feet in both diameter and length, the moving parts weighing approximately 25 tons each. They are capable of receiving and crushing rocks of 5 tons or less. The crushing faces are made up of chilled cast-iron plates, placed longitudinally and securely bolted into the solid mandrel of the roll. The surface of each plate presents two rows of projecting lugs. On one row, two of the plates are supplanted by "slugger plates," the corrugations of which extend slightly beyond the rest to act more or less as a sledge-hammer in breaking up the rock. The crushers are driven at 200 revolutions per minute, corresponding with a peripheral speed of over 300 feet per minute. Beneath the giant rolls is a 10-ton hopper, from which the material is fed to three sets of 36-inch rolls. The first set is provided with a flywheel on the extended shaft of one roll to assist in crushing the larger pieces passing through the giant rolls. The first and second sets of smaller rolls run in rigid bearings, giving fixed distances to the crushing faces. In the third and last set, the rolls are dra n together by nests of helical steel springs, to accommodate the spacing to the material which passes through. The rock in passing through the four sets of rolls is reduced to ½-inch in size. Tailings from the screens to which the crushed rock is conveyed are brought to the crusher house and passed through the lowest roll. The entire plant of rolls is driven by belting through a friction brake from a 500-horsepower, vertical, cross-compound Allis engine, operated condensing. Owing to their great mass, the giant rolls are started by hand before they are thrown upon the engine. A 100-kilowatt generator is also driven by the engine to supply current for the motors in this department, a plan which has been followed in the case of the two other large tower engines, for the purpose of rendering each department as independent as possible. As a result, the central electric station is far smaller than it otherwise would be. The crusher house has a capacity of 3,000 tons per day of twenty-four hours, allowing for sixteen hours of actual running and four hours of stoppages as a maximum.

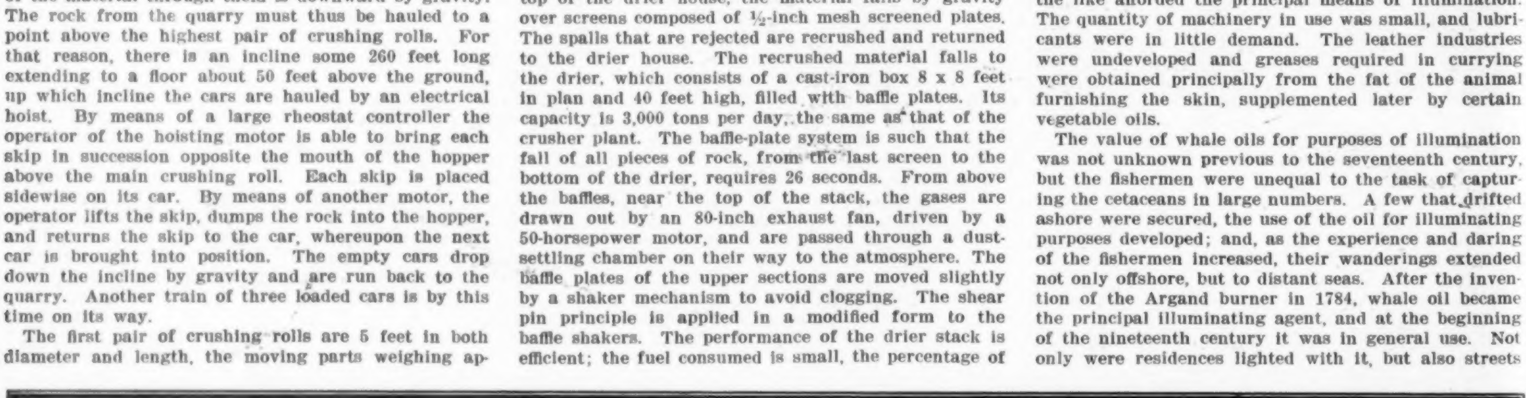
CLINKER COOLER AND CONVEYER.

The crushed rock from the lowest set of rolls drops through a chute upon a 24-inch belt conveyer, which is upwardly inclined and which carries the rock to the top of the drier house. As a general rule, all the belt conveyers in the plant are run flat. After reaching the top of the drier house, the material falls by gravity over screens composed of ½-inch mesh screened plates. The spalls that are rejected are recrushed and returned to the drier house. The recrushed material falls to the drier, which consists of a cast-iron box 8 x 8 feet in plan and 40 feet high, filled with baffle plates. Its capacity is 3,000 tons per day, the same as that of the crusher plant. The baffle-plate system is such that the fall of all pieces of rock, from the last screen to the bottom of the drier, requires 26 seconds. From above the baffles, near the top of the stack, the gases are drawn out by an 80-inch exhaust fan, driven by a 50-horsepower motor, and are passed through a dust-settling chamber on their way to the atmosphere. The baffle plates of the upper sections are moved slightly by a shaker mechanism to avoid clogging. The shear pin principle is applied in a modified form to the baffle shakers. The performance of the drier stack is efficient; the fuel consumed is small, the percentage of moisture in the crushed rock being reduced from three or four per cent to within one per cent. The gases emerge at a temperature scarcely above 212 deg. A further drying is accomplished in the stock bins in a manner to be later described.

At the transfer tower an automatic sampler is installed, which withdraws samples of the material as it is dumped from one conveyer to the conveyer running into the stock house. This sampler consists broadly of a plate, hinged like a damper and thrust periodically into the material, as it falls from one conveyer to the other. The plate is forced into the stream of crushed material in response to an escapement mechanism which is belted to the conveyer shaft, so that the periodical movement of the plate has a definite relation to the speed of the conveyer. As it is thrust into the falling stream of crushed rock, a weight returns the plate quickly to its original position. The sampler catches one pound of crushed rock per minute; while the full capacity of the conveyer is 200 tons per hour. The number of samples which are thus taken afford a ready means of obtaining a good average.

From the bottom of the drier stack a 24-inch belt conveyer carries the dried rock up an incline to a transfer tower, where it is delivered to a 24-inch belt conveyer, already indicated, which traverses the full length of the stock-house cupola and deposits its load into any desired bin by means of a self-propelling tripper of special design. Three bins are used for cement rock and three for the lime rock. An extra bin serves for mixing purposes. From the results of the analyses of the material removed by the automatic sampler, it is possible to ascertain the general constituents of the material in any one bin. Mixtures of cement, rock, and limestone can be made by discharging from the bins in question upon belt conveyers running in a tunnel underneath the bins. The tunnel belt carrying the mixture brings it to a second transfer tower where it is discharged upon one of the head-house conveyers. If the material is to be taken from the stock house for the next step in the process of manufacture, the second belt in the tunnel is employed. From the bottom of each bin there extend downward six plate steel hoppers, each supplying two roller feeds, delivering to two belt conveyers. Each set of these roller feeds is driven by a continuous shaft geared to a 5-horsepower motor. To avoid the effects of tunnel dampness upon the motors, the operating switches are so arranged that when each motor is idle a 220-volt incandescent lamp at the switchboard is lighted by a current through the field windings. The warming effect of this current is sufficient to keep the motor dry. Elaborate precautions have also been taken to dry the material in the stock house should it become wet after it is delivered from the drier. The furnace at one end of the building and a large fan 15 feet in diameter at the other end are the means employed. When excess moisture is present in the stored stock the fan serves to create a suction of warm air through the building from the furnaces at the other end. This fan, which is direct-connected to a 15-horsepower motor, is designed to pass 60,000 cubic feet of air per minute.

(To be continued.)



A GENERAL VIEW OF THE COLONY OF BUILDINGS CONSTITUTING THE EDISON PORTLAND CEMENT WORKS.

FISH OILS, FATS, AND WAXES.

By CHARLES H. STEVENSON.

PREVIOUS to 1600 there was comparatively little demand for oil of any kind. Tallow dips, pine knots, and the like afforded the principal means of illumination. The quantity of machinery in use was small, and lubricants were in little demand. The leather industries were undeveloped and greases required in currying were obtained principally from the fat of the animal furnishing the skin, supplemented later by certain vegetable oils.

The value of whale oils for purposes of illumination was not unknown previous to the seventeenth century, but the fishermen were unequal to the task of capturing the cetaceans in large numbers. A few that drifted ashore were secured, the use of the oil for illuminating purposes developed; and, as the experience and daring of the fishermen increased, their wanderings extended not only offshore, but to distant seas. After the invention of the Argand burner in 1784, whale oil became the principal illuminating agent, and at the beginning of the nineteenth century it was in general use. Not only were residences lighted with it, but also streets and municipal buildings. A large quantity of sperm oil was used in residences of the wealthy and also in lighthouses, that being the principal illuminant in the coastal lights of the United States, England, Scotland, Ireland, France, and other advanced countries up to 1832. The currying trade had in the meantime increased in importance, and grease for softening was secured in the form of oil from seal, walrus, sea-elephant, cod livers, etc. The increasing use of machinery resulted in an enhanced demand for a lubricant, which was generally furnished in the form of sperm oil. This resulted in very high prices; sperm

oil, for instance, ranged from $1 to $2 per gallon, although the fishery increased until it was one of the most important organized industries of the world. Other fish oils became important commercial products, including oils from the livers of cod, haddock, sharks, etc., from herring, menhaden, sardine, pilchard, and other species of the *Clupeidæ* family, and a miscellaneous variety of minor importance.

The continued upward tendency in prices, as a result of an increased demand, led to endeavors to find substitutes. Lard oil was successfully introduced as a summer lubricant in the place of sperm oil for ordinary uses. Colza or rape-seed oil likewise entered into competition with it as an illuminant, and the process of refining was improved until it became a fairly satisfactory substitute at about half the price. In 1832 France adopted colza in place of sperm oil as a lighthouse illuminant, and in 1845 it was adopted in the lighthouses and lightships of Great Britain. The difficulty of obtaining rape-seed oil in the United States and the importance of the whaling industry to the national welfare caused the use of sperm oil in this country for ten years longer, when through the researches and experiments of Prof. Henry it was found practicable to use lard oil, and in 1862 that became the illuminant in the lighthouses of the United States. A few years later both colza and lard oils were superseded by forms of petroleum.

Not only did the products of petroleum take the place of aquatic-animal oils as illuminants, but they seriously interfered with them in the markets as lubricants. Then came the development of rendering and refining a large number of vegetable oils, which are now used for many purposes formerly served by fish oils. Among these vegetable products are olive oil, cotton-seed oil, linseed oil, and, to a less extent, palm oil, cocoanut oil, corn oil, etc. The employment of these substances and a large decrease in the abundance of whales have resulted in a great reduction in the extent of the whale fishery, the fleet decreasing from 735 vessels in 1846 to 38 in 1902. Those marine enterprises more or less attributed to various minor oils, as those from the shark, eulachon, manatee, dugong, alligator, terrapin, etc., but the use of these is not general.

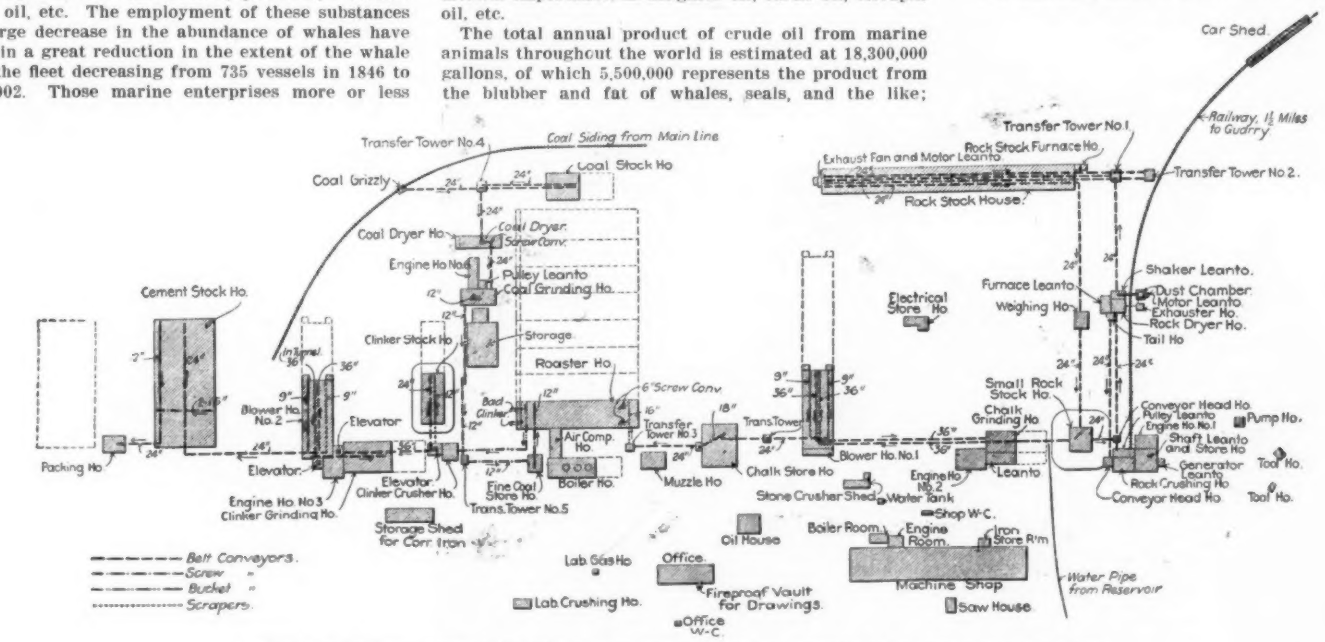
The marine animal oils are divisible into four principal groups, viz.: (1) blubber oils; (2) head oils; (3) liver oils, and (4) body oils. The blubber oils are obtained from the layer of fat between the skin and the flesh or muscular tissues of whales, seals, walrus, sea-lion, porpoise, black-fish, etc. Head oils are secured from cavities in the skull and from other parts of sperm whales, black-fish, porpoise, sword-fish, halibut, etc. Some of these are of superior quality, as those of the black-fish and porpoise, for instance, which sell for $5 to $10 per gallon. The head oil of the sperm whale yields the valuable spermaceti. Those of the third group are obtained principally from the livers of cod, and to a less extent from haddock, hake, pollock, cusk, ling, sharks, and skates. The bodies, heads, and viscera of these fish are so slightly oleaginous that they are rarely utilized economically for oil purposes. The body oils, or fish oils,* as they are now generally known commercially, are obtained principally from species of the herring family—the menhaden in America, the herring, sardine, and pilchard in Europe, and the iwashi in Japan. In case these fish are used for food in large quantities, the viscera are generally devoted to oil rendering. Most of the other species of food-fish contain so little oil that it is profitable to use only the intestines or other refuse dressings for this purpose. And in some the yield of oil is so small that not even the waste parts can be profitably utilized in this manner. In addition to the foregoing, there are a number of oils produced in various localities which enter largely into the domestic economy of those procuring them and yet are of little commercial importance, as alligator oil, turtle oil, terrapin oil, etc.

The total annual product of crude oil from marine animals throughout the world is estimated at 18,300,000 gallons, of which 5,500,000 represents the product from the blubber and fat of whales, seals, and the like; unless the closest economy is practised. The vessels composing the present sperm-whaling fleet, for instance, may be kept employed with a fair profit, but with the present prices the fitting out of expensive new vessels can scarcely meet with a large return on capital invested. The present equipment of menhaden steamers and factories was built and paid for during a period of prosperity, when menhaden oil was high in price, and they may be continued in service with profit, but the conditions are not encouraging for a great extension of the industry. If a profitable market could be found for the product, the yield of fish oils throughout the world could probably be increased many times its present extent.—U. S. Fish Commissioner's Report.

A NEW KIND OF WATERPROOF FABRIC.

It has been proposed to precipitate an insoluble soap upon the fibers of a textile fabric in order to render the same waterproof; but this process has not been attended with practical success. The fabric so treated is rendered only partially resistant to water and cannot be regarded as thoroughly waterproof. Armand Mueller-Jacobs states he has discovered, however, that if during the process of precipitating an insoluble soap upon the fibers of a textile fabric a gas, such as carbonic dioxid, is liberated in the midst of the chemical reagents whose mutual reaction results in the precipitation of an insoluble soap upon the constituent fibers of the fabric, simultaneously with those reactions such carbonic dioxid in a state of infinitesimal division becomes fixed in the resulting precipitate and is held occluded therein in such manner as greatly to increase the water-repellent capabilities of the textile fabric so treated.

The following mode of procedure as applied to cloth,



THE GENERAL ARRANGEMENT OF THE EDISON PORTLAND CEMENT WORKS.

associated with the whale fisheries, as the taking of seals, sea-elephants, walrus, etc., have decreased correspondingly.

Fish oils have, therefore, to a large extent, given place to land products, and their diminished sale and reduced price have greatly decreased the prosperity of many fisheries. At present the use of fish oils for illumination as compared with that of mineral oils is very small in those countries where the latter are obtainable, their principal use being in miners' lamps. But among many semi-civilized people, especially those of sub-polar regions, marine-animal oils are more easily obtained than petroleum, so that the native products continue in use. And notwithstanding the large amount of mineral oils now used for lubrication of heavy machinery, there is yet an extensive demand for fish oils for that purpose, experience having shown that by their judicious blending with hydrocarbon oils a greater uniformity of lubrication is secured, and that less quantity is required than by use of mineral oil alone. The outlook for an increased use of fish oils in leather-dressing is said to be not encouraging, owing to a decrease in "hand-stuffing" and the increasing popularity of chrome tannage, in which only a small quantity of oil is required, and that usually a superior quality of neatsfoot. There is a wide field of technical uses wherein certain fish oils cannot readily be dispensed with, especially for lubricating delicate machinery, in steel tempering and screw cutting, as a body for paints to be applied to out-of-door surfaces, in the textile trades where only saponifiable oil can be satisfactorily employed, etc.

In addition to their many technical uses, marine-animal oils are also used for nourishment to a considerable extent. The Eskimos and other primitive people depend very largely on the blubber of seals, walrus, and whales, for food supplies. Among more civilized nations fish oils are not used ordinarily as an article of diet; an exception, however, is the well-known and valuable cod-liver oil, of which twenty or thirty thousand barrels are annually consumed in cases of malnutrition. Certain therapeutic qualities are also

5,300,000 gallons is from the livers of cod, shark, etc., and 7,500,000 gallons from menhaden, herring, sardine, and other species, including waste in dressing fish.

Even a brief survey of the fish-oil industries reveals the fact that they are not by any means so extensive as the natural resources permit. True, the right-whale fishery is prosecuted apparently to an extreme limit, and the same is possibly true of the seal fisheries of certain regions. However, there is probably no other oil-yielding fishery of which the same can be said. Sperm whales are more numerous than they were fifty years ago, when the United States employed 300 vessels in their capture, securing 100,000 barrels of oil annually, as compared with the present product of less than 20,000 barrels. Porpoise and other small cetaceans exist in such large numbers that hundreds of thousands if not millions of gallons of oil can be secured from them. Only a very small percentage of the oil-yielding sharks are utilized. Much greater quantities of menhaden might be taken than are secured at present, and comparatively little of the abundant waste fish and dressings or refuse from the markets, canneries, etc., are used in oil production.

The principal reason for this is that the present economic conditions do not warrant an extension of these industries. The market for fish oils is regulated by that of the mineral and vegetable products which are used as substitutes, and which can be sold at very low prices, making it necessary to exercise very great economy in the production of fish oils. Vessels, factories, etc. already on hand may be used, but in the United States at least it is questionable whether the building of new and costly equipment for oil production would prove profitable under present market conditions except in specially favorable instances,

* The term "fish oil" is used by chemists and other technologists as comprising oils from all aquatic animals. Previous to 1800 it generally referred to whale oils. At the present time its commercial use is generally confined to oils obtained from fish alone. In a restricted sense it refers especially to oil obtained from the principal species of the herring family in the locality in which the term is applied. Thus "fish oil" on the Atlantic coast of the United States indicates in a restricted commercial sense the oil of the menhaden; in Norway, the herring; in France, the sardine; in Japan, the iwashi, etc.

for instance, will serve as an example of the process which has been found to produce the best practical results: The first bath with which the cloth is to be impregnated, is prepared by adding to one hundred parts of water ten parts of stearic acid, one and one-half parts of sodium hydrate, and two parts of sodium bicarbonate. The mixture is boiled to complete solution, and then five hundred parts of water are added thereto.

The second bath consists of a solution of aluminium chlorid having a specific gravity indicated by 7 deg. to 10 deg. of Baumé's hydrometer and containing, in addition, from three to five parts of acetic acid standing at 10 deg. Baumé.

The cloth to be treated is passed through the first bath maintained at a temperature not below 180 deg. Fahrenheit in such manner as to become thoroughly saturated therewith, and then the excess of liquid is expressed therefrom by running it between squeezing-rollers, as in the well-known apparatus used for ordinary wet operation of the dye-house. The cloth is next passed through the second bath at ordinary temperature in such manner as to bring about within and upon the constituent fibers of the cloth the chemical and physical changes due to the reaction between the ingredients of the first bath still retained therein and the ingredients of the second bath brought in contact therewith.

Care should be taken to keep the second bath always in an acid state. As soon as it tends to become neutral more acetic acid should be added. When the cloth passes from the second bath, it should have the excess of liquid squeezed out of it, and should thereupon be thoroughly washed out in running water. After that it is dried and may be calendered.

In the reactions of the ingredients of the second bath upon the ingredients of the first bath with which the cloth has been saturated there are precipitated in and upon the textile fibers the two insoluble compounds, aluminium stearate and aluminium hydrate, while carbonic dioxid is liberated, and a part of this gas in a finely-divided and discrete state is distributed

through the insoluble compound and occluded or permanently fixed therein. Ordinary cotton cloth thus treated is said to be so completely impervious to water that when bulged or folded in such manner as to form a bowl-shaped depression or pocket it will hold water therein for days without letting a drop escape through its meshes and without becoming moist upon its under side.

In the first bath potassium stearate may be substituted for sodium stearate and potassium bicarbonate may be substituted for sodium bicarbonate; but the inventor prefers the sodium compound. So, likewise, may palmitic acid or oleic acid be substituted for stearic acid, but with inferior results.

THE EMERY TESTING APPARATUS AT THE MASSACHUSETTS INSTITUTE OF TECHNOLOGY.*

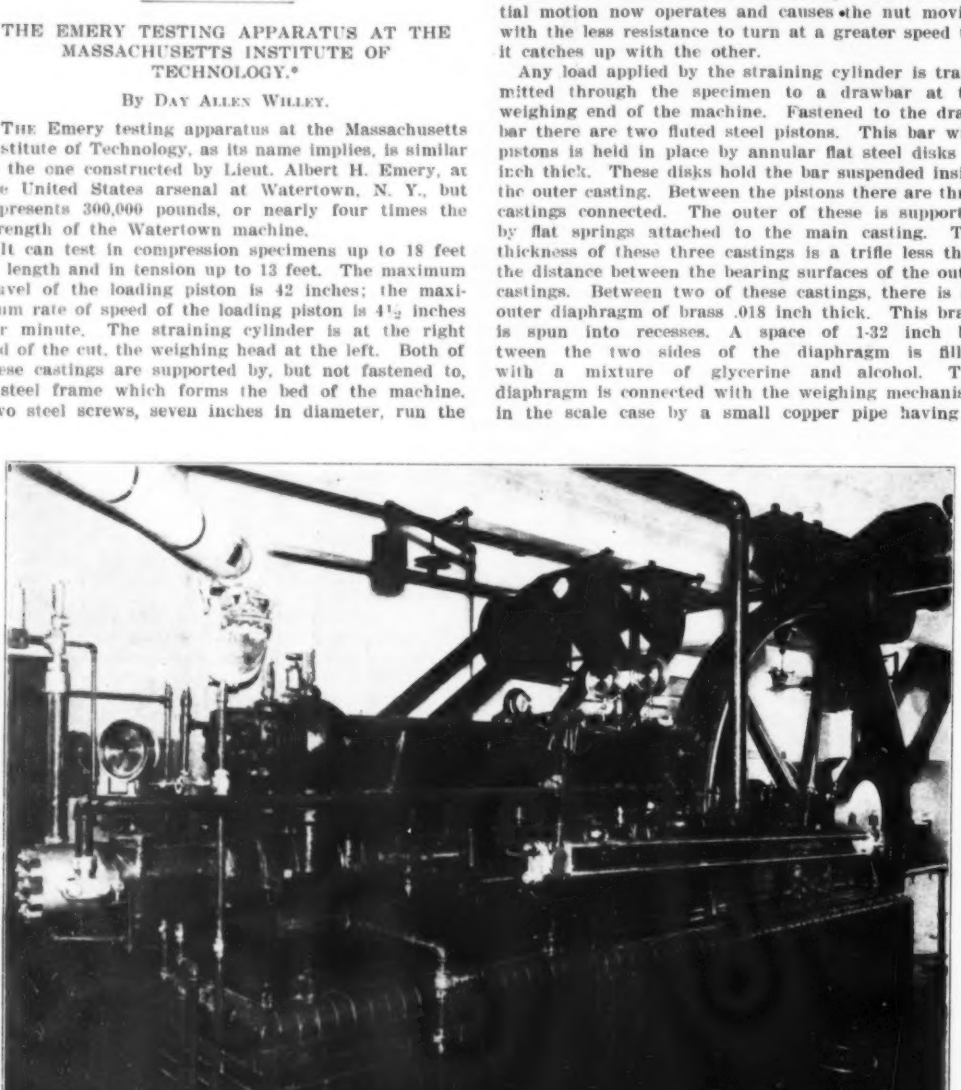
By DAY ALLEN WILLEY.

THE Emery testing apparatus at the Massachusetts Institute of Technology, as its name implies, is similar to the one constructed by Lieut. Albert H. Emery, at the United States arsenal at Watertown, N. Y., but represents 300,000 pounds, or nearly four times the strength of the Watertown machine.

It can test in compression specimens up to 18 feet in length and in tension up to 13 feet. The maximum travel of the loading piston is 42 inches; the maximum rate of speed of the loading piston is 4½ inches per minute. The straining cylinder is at the right end of the cut, the weighing head at the left. Both of these castings are supported by, but not fastened to, a steel frame which forms the bed of the machine. Two steel screws, seven inches in diameter, run the entire length of the machine. They are threaded for a length of about 19 feet. They pass through the weighing head, and are securely fastened to it by steel nuts. Castings through which the screws can slide support the right-hand end of the screws. Two cylinders containing buffer springs are bolted to the left-hand end of the frame. These springs push on the end of the steel screws.

When a tension specimen breaks suddenly, the straining cylinder recoils to the right and the weighing head and screws recoil to the left; in this way the buffer springs get an additional load each recoil, till finally they are compressed sufficiently to be able to start the weighing head to the right. Once started, the head moves back to its original position. The seven-inch steel screws have to carry whatever load may be put on the specimen. If the specimen is in tension, the screws are under compression, and *vice versa*. The straining cylinder is a closed hydraulic cylinder with piston and piston-rod packed with cup-shaped leather packing rings. The cylinder is entirely filled with oil, which is supplied and exhausted through a jointed folding pipe. If the machine is working in tension, the oil under pressure enters at the left-hand end of the cylinder and an amount of oil equal to that entering is driven out of the other end of the cylinder, back through one set of the folding pipes to the suction chamber of the power pump which forces the oil. The straining cylinder may be moved along the bed to such positions as the different lengths of test pieces may necessitate. This is accomplished by rotating two large nuts on the seven-inch steel screws, these nuts turning inside the enlargements seen on the sides of the casting. The nuts are four inches narrower than the width of the recess in which they turn, thus allowing for the recoil already spoken of. After moving the straining head to a new position on the screws the nuts must be brought up against the proper bearing side of the recess. While moving the straining head the nuts are driven by pinions engaging with spur gears on the outside of the nuts and the pinion shafts are in turn driven through sets of bevel gears by a shaft turned by a rope wheel. An epicyclic train of gears, serving as differential gears, is introduced in this driving mechanism, the object being to keep the resistance offered by the two nuts the same. If, for any reason, one nut should advance faster than the other, due perhaps to a slight difference in the pitch of the two screws, that nut, on account of the added work, would turn harder than the other nut. The differential motion now operates and causes the nut moving with the less resistance to turn at a greater speed till it catches up with the other.

Any load applied by the straining cylinder is transmitted through the specimen to a drawbar at the weighing end of the machine. Fastened to the drawbar there are two fluted steel pistons. This bar with pistons is held in place by annular flat steel disks ⅛ inch thick. These disks hold the bar suspended inside the outer casting. Between the pistons there are three castings connected. The outer of these is supported by flat springs attached to the main casting. The thickness of these three castings is a trifle less than the distance between the bearing surfaces of the outer castings. Between two of these castings, there is an outer diaphragm of brass .018 inch thick. This brass is spun into recesses. A space of 1-32 inch between the two sides of the diaphragm is filled with a mixture of glycerine and alcohol. The diaphragm is connected with the weighing mechanism in the scale case by a small copper pipe having a hole about 1-20 inch in diameter. At the left-hand end of the drawbar there are five springs under compression. By means of the handwheel at the extreme left, the force of these springs can be taken as a push, or as a pull, on the drawbar. These springs exert force enough to more than overcome the resistance to bending offered by the steel disks supporting the drawbar.



THE EMERY TESTING APPARATUS.

Suppose the machine is to be used for compression work. The handwheel is turned so as to cause the five springs to exert a pull on the drawbar. As a result, the drawbar moves to the left a very small distance. As it moves, the right-hand piston on the drawbar pushes the castings holding the diaphragm to the left till the left-hand one brings up on the bearing surface of the outer casting. The extra force of the springs causes a slight squeeze to be given the liquid inside the diaphragm. This increased pressure is transmitted through the copper pipe to the scale case. In the scale case there is an inverted steel cup having a brass diaphragm on its lower face. This cup connects through the copper pipe with the annular diaphragm already described. Pressure on the diaphragm is transmitted through to the lever system, where it may be weighed by putting weights in the different scale pans. The initial load put on by the extra force of the five springs is counter-balanced by moving the balance weight to the right. The knife edges used in the lever system are thin pieces of steel, driven into slots cut into the levers. The machine has to be rated, when made, by comparing it with a sensitive lever machine made especially for this use. The weights are gold-plated disks carried in cages moved by four handles. Suspended from the weighing beam are four cages similar to the others, but with lugs spaced in such a way that if the cage moved by a handle is raised one notch, one disk is transferred from the handle cage to the beam cage. At the same time the motion of the handle indicates, through figures, at the end of the indicator needle, the number of weights on the beam.

It will be noted that, with experimental apparatus of the size indicated, sections of wood and metal equal in dimensions to material used in the construction of buildings, bridges, vessels, rolling stock for railroads, etc., can be mechanically "dissected," so to speak, and their actual value for this or that service be determined. Some of the tests conducted by the students have been made with steamship shafts, steel girders intended for railway and wagon bridges, axles for freight and passenger cars, as well as locomotive parts. As the notes of each test are carefully recorded, data has been compiled at the institute which is of much value to engineers and contractors. To furnish the requisite power to operate the larger machines, not only steam, but compressed air and hydraulic machinery have been installed of adequate capacity. The steam laboratory contains a triple-expansion engine, with cylinders of 9 inches, 16 inches, and 24 inches diameter, respectively, and 30 inches stroke, arranged in such a way as to be run single, compound, or triple, as desired for the purpose of experiment. This engine is of the Corliss type, and has a capacity of about 150 horse power when running triple, with an initial pressure of 150 pounds in the high-pressure cylinder. It is connected with a surface condenser and the other apparatus necessary to adapt it to the purposes of accurate experiment. A tandem compound high-speed engine of about 225 horse power, having cylinders 11 and 19 inches in diameter by 15-inch stroke, is similarly provided with surface condenser, air-pump, and other apparatus needed for testing. This engine transmits its power through a rope drive. This laboratory also contains a three-stage air compressor adapted to compress 100 cubic feet of free air per minute to 2,500 pounds pressure per square inch, connected with storage tubes of about 58 cubic feet capacity, and apparatus for accurately determining the weight of air flowing through orifices up to 2 inches in diameter and at pressures of under 350 pounds per square inch.

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

THE COST OF POWER.

THE opening of the winter session of the Liverpool Engineering Society, which took place on the 4th inst., was signalized by the new president, Mr. T. L. Miller, delivering his inaugural address. As is well known, Mr. Miller has identified himself in his professional career with questions more especially involving sources of motive power, and in his address he had collected a number of useful statistics bearing on this subject. In regard to water power, the author found, as was natural, great variation in the cost; for instance, in France it ranges from almost a nominal sum under favorable circumstances up to more than the cost of steam power. In Switzerland the average rate is only £6 per horse power per annum. In the case of Niagara the charge for power varies, according to the quantity used per month, from 1d. to 0.32d. per unit. In France and Switzerland the author found that the cost of electrical energy for power purposes from water stations varies from 1.05d. per unit for small powers, up to 0.63d. for large powers. In the Southern States of the Union an extremely low figure prevails, for it appears that the cost of energy works out at 0.218d. per unit, supposing full advantage is taken of the supply of energy available. The figure corresponding to this would be £3 2s. 6d. per horse power per year delivered on the transformers. In a table dealing with the efficiency of the steam engine a compound engine of 215 horse power by Van der Kerchove with superheated steam at 130 pounds boiler pressure and piston speed of 718 feet per minute, 8.86 pounds of steam only are said to be required per indicated horse power per hour. With the steam turbine, which, of course, cannot be indicated in the manner of the reciprocating engine, the best result recorded in the table was 18 pounds of water per kilowatt-hour. This was with a Parsons turbine of 1,442 horse power, steam pressure 196 pounds to the square inch, and 27 deg. Fahr. superheat. In dealing with the gas engine, the address stated that since 1882 the efficiency has been increased from 15.2 per cent to 33.65 and 37.66 per cent in accordance with the thermal efficiency of the gas used, the advance being largely due to higher compression. The address also contained a table of cost for power in various industries, the figures varying through very wide limits.

Experiments have been carried out in England with a new dust-laying preparation known as westrumite, to overcome the raising of heavy clouds of dust by automobiles. The preparation, which is the invention of a German, Herr van Westrum, is a mixture of oil, capable of dilution to any desired extent, and distributed over the road surface by means of an ordinary water-cart. After the evaporation of the water, the westrumite remains as a moist surface or film upon the road, and absolutely prevents clouds of dust to arise. Some interesting demonstrations with this preparation were given at the Crystal Palace. The road surfaces were sprinkled early in the morning after three days without rain and with a good deal of sun, and in the afternoon three cars, a 22-horsepower Daimler and a 7 and a 10-horsepower Panhard respectively, were run over a sprinkled portion at top speed, and did not raise any dust, whereas in running over the untreated portions of the roadway, heavy, thick clouds of dust were created by the automobiles.

Correspondence.

THE POSSIBILITIES OF THE AERODROME.

To the Editor of the SCIENTIFIC AMERICAN:

Having many inquiries anent the plausibility, historically considered, and the feasibility from the mathematical standpoint, of the aerodrome illustrated by the writer in your SUPPLEMENT of October 25, 1902 (No. 1399), I send for your perusal, and, in view of the present abstract and concrete public interest in the subject, for publication if you see fit, a letter I had recent occasion to send to an inquirer. The letter speaks for itself, and runs as follows:

December 3, 1903.

My Dear Sir: I have found the reference you made to Mr. A. M. Herring's criticism of vertical aerial screw propellers, which you thought might have a bearing upon the practicability of my machine, in the Aeronautical Annual of 1897, on page 55, which reads as follows; the which, with the further citations and comments, I feel, should be sufficient answer to those who incline to ask what I find in the literature of the subject against the navigation of the air by the plan I have proposed:

"The vertical screw machines have much to recommend them, but there are far greater difficulties offered to their production than would be supposed. The ability to rise directly into the air from any given spot would be an exceedingly desirable quality. And hence we find that the great majority of experimenters who attack the problem of dynamic flight begin here, starting with a plan of some modification of this type of machine. The stumbling-blocks, however, are soon met. Not least among them is the fact that when the surfaces which form the blades of the screws are revolved over one spot (as they must be to rise directly into the air) they do not give any considerable lifting effect in proportion to the power consumed; for where one might from the theory even of the aeroplane expect a lift of possibly 100 pounds per horsepower, the best result the inventor can produce on a practical scale is pretty sure to be less than one-seventh of that figure."

This is an expression of opinion of a capable, possibly biased, but not infallible person, stated eight or ten years ago and before the modern development of power in small units, regarding screws fashioned like steamship propellers to be used for thrust or fulcrum upon the atmosphere. The especial construction of the aerial screws devised for my machine, on the contrary, in the opinion of Mr. Chanute, as also the writer, is vastly more efficient; and further, it is not essential that they should revolve in one spot. However, with these deprecating figures of Mr. Herring's critical statement—one-seventh of 100 pounds per horsepower—I will lift my machine and carry about 200 pounds contingent load, including operator. I do not ask to be able to do more than this, but I think I shall. I never for one moment expected to raise 100 pounds per horsepower, and actually need only about one-eighth of it. Messrs. Maxim attained 133 and Langley 200 pounds lift per horsepower with aeroplanes operated on the straightaway plan.

Set over against the above, however, is the statement of fact given by an older and possibly more thoroughly informed person, Mr. Chanute, of Chicago, in his book "Progress in Flying Machines," 1892, page 53. M. Nadar's experiments with vertical acting screws. "Manifesto Upon Aerial Automotion," Paris, 1863. (Further citations are from the same record indicated by page.)

"Such experiments as were tried with (vertical) aerial screws (outside of the little toys which were exhibited at the various meetings) demonstrated that the utmost weight which the exertion of one horsepower could sustain, with a screw acting upon the air, was some 33 pounds, or, in other words, that if the apparatus were to weigh one ton, it would need 67 horsepower continuously exerted to keep it afloat. And so the utmost weight available for the motor of the screw and its supplies would be one-third of 33 pounds, or 11 pounds to the horsepower, while in 1863 there was no primary motor known then approximating such phenomenal lightness."

According to these figures, based on alleged facts, the reasonable expectation of this machine as at present planned (30 horsepower) is to lift 1,000 pounds, or about twice the lift necessary to commercially navigate the air and carry two operators. So far as our present knowledge serves, this I believe to be a conservative statement. I expect to attain considerably under 5 pounds weight per horsepower in my motor, and this is not at all extraordinary, in view of the present state of the art; but the present state of the art does not seem as yet to be realized. Mr. Maxim's wood screws gave a thrust of 25 pounds per horsepower at starting and 50 pounds per horsepower when in the air, and you see that the average very well conforms to the above Paris tests of 33 pounds per horsepower.

Mr. Wenham, of the Aeronautical Society of Great Britain, measured the power of a vertical flying toy devised by Penaud and (page 56) "computed that to maintain the flight of the instrument, weighing 396 grains, a constant force is required of near 60 foot-pounds per minute, or in the ratio of about 3 horsepower for every 100 pounds." (Thirty-three pounds per horsepower.)

The report to the French Aeronautical Society of its Secretary M. Dieuaide of an experiment with aerial screws, says (page 60) that "this double screw could not, in consequence of the losses of power due to the gearing, exert a lifting force greater than that of 26.4 pounds per horsepower. This agrees closely with the results of the experiments of Giffard with a single screw, he having found that 6 horsepower would lift with a screw 165 pounds at the rate of 3.28 feet per second, or say 27.5 pounds per horsepower."

And again, M. Forlanini's experiments with screws and a self-generating steam boiler are summed up as follows (page 64):

"This, then, is the best that has hitherto been done with steam. A model screw machine weighing 7.7 pounds has risen 42 feet into the air. The power developed ranged from 7,800 to 10,850 foot-pounds per minute, and the total weight sustained was at the rate of 26.4 pounds per horsepower."

Had you the inclination, it would be well to read pages 66 and 67 of "Progress in Flying Machines" recounting Messrs. Dahlstrom and Lohman's experiments at the Royal Dockyards at Copenhagen (reported to the British Association in 1886 by H. C. Vogt) relating to the relative efficiencies of water and air screws. In this test, "it was found that not only would the aerial propeller develop as great a thrust as the water propeller in proportion to the energy consumed, but that under certain conditions it would do slightly more." (I am informed this phenomenon has been confirmed on the Erie Canal in this country.) "At 52 revolutions per second, requiring the expenditure of 100 foot-pounds, the thrust of the screw against a stop was 6 pounds, and its efficiency therefore was 6 × 550 ÷ 100 = 33 pounds per horsepower." In these tests with screws the very considerable lift of 55 pounds per horsepower is recorded. Further records of screw thrust (page 253): Moy, 40 pounds per horsepower; Renaud, 48 pounds per horsepower; Lohman, 37.6 and 55 pounds per horsepower. In short, to sum up broadly, by taking the average of experimental tests and tests in actual practice, it is safe in assuming that 100 pounds per horsepower can be sustained in horizontal flight with aeroplanes, and 45 pounds per horsepower can be sustained in horizontal flight with aerial screws efficiently designed. Mr. Chanute truly says that "while a flying machine in which the sustaining power is to be obtained from rotary screws is likely to require less surface than an aeroplane to sustain the same weight, perhaps in the proportion of about one-third, yet it is likely to require more power than the aeroplane to obtain the same speed of translation."

Other citations of recorded facts can be given in support of the contentions made for this machine, but these will suffice. Since the type of flying apparatus involving inherent stability and automatic control was evolved in the early eighties, I have taken recent advantage of an opportunity to read up the advanced experimental history of this art, and will say the more I read the record, the more is the opinion of its practicability confirmed, and that in the not distant future I will not be alone—mark the words—in its advocacy. The right lead struck and followed will solve this physical problem, but it is one of those things that the ways how to do it are not nearly so many as the ways how not to do it, and how not to do it is, in my judgment, soon learned.

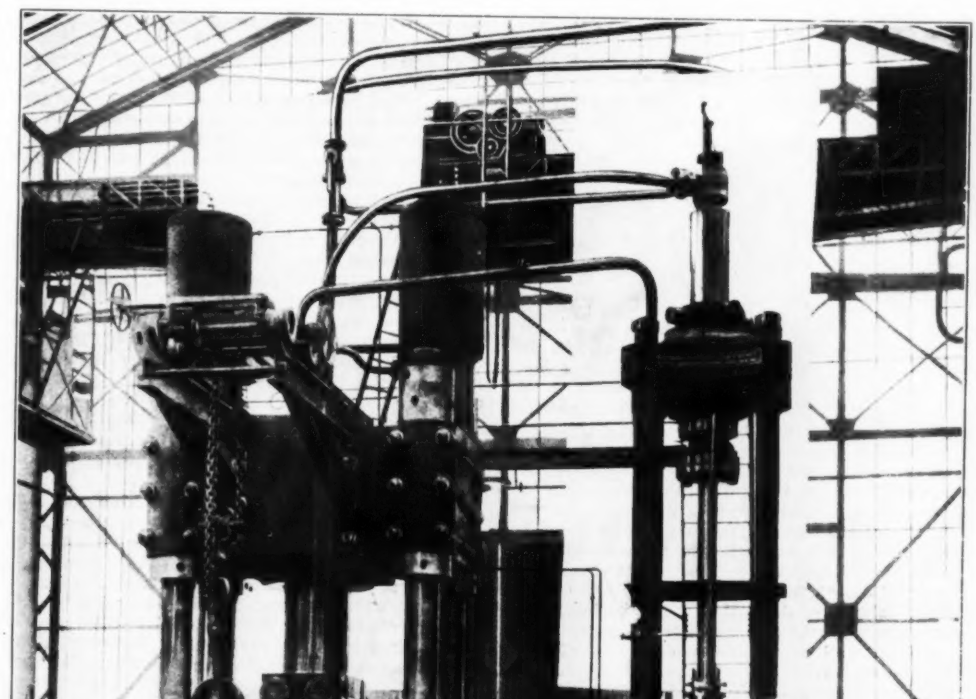
Very truly yours,

Passaic, N. J., December 28, 1903. S. D. MOTT.

AN AUSTRIAN STEAM-HYDRAULIC FORGING PRESS.*

IN the Imperial arsenal at Vienna is a 1,200-ton forging press which consists of a steam-hydraulic intensifier and a press proper.

The steam-hydraulic intensifier has a vertical steam cylinder 1,140 millimeters (3 feet 9 inches) in diameter, the stroke being 2,000 millimeters (6 feet 6¾ inches). The piston-rod, which measures 170 millimeters (6 11-16 inches) in diameter, is continued upward and forms the plunger of the hydraulic cylinder which is situated vertically above and directly in line with the steam cylinder.



A 1,200-TON FORGING PRESS.

This hydraulic cylinder is supported by a head carried upon four columns, and the tensional strains in these columns are transmitted directly to the foundation bed-frame below the steam cylinder.

The relation between the diameters of the steam-piston and its piston-rod, which is used as a plunger, is such as to increase the initial steam pressure of 10 atmospheres (150 pounds per square inch) to 450 atmospheres (6,750 pounds per square inch). At this latter pressure the hydraulic press is actuated.

The only valve gear necessary consists of a balanced piston valve situated in the steam circuit and quite easily actuated by a hand lever, as it works under only 150 pounds per square inch pressure.

The press proper consists of a massive bed-plate, made in sections, which carries besides the anvil and blocks, four steel pillars which in turn support the two top heads between which the press cylinder, a steel casting, is carried.

The diameter of the press cylinder is 600 millimeters

* Specially prepared for the SCIENTIFIC AMERICAN SUPPLEMENT.

(1 foot 11⅝ inches). The ram is flanged and connected to the middle head by means of bolts and rings shrunk on. The middle head, which carries the upper press block, is well guided on the four columns.

The top heads carry, besides the hydraulic cylinder, two steam returning cylinders, the piston-rods of which are directly connected with the middle head.

To support the material being worked, one side of the top head is fitted with brackets upon which a small crane-wagon runs.

A water reservoir situated above the press allows of the press middle head being lowered without using pressure water.

The press can work in either of two ways: By giving short, quick strokes, or long, full strokes of 160 millimeters (6 5-16 inches) each, which latter are equivalent to a full stroke of 2,000 millimeters (6 feet 6¾ inches) of the intensifier.

In the first case, the steam valves of the returning cylinders are fixed, so that the cylinders are continually under steam pressure; the working lever is then depressed, the intensifier piston is forced upward, thus causing the ram of the press to descend. By reversing the lever the motion is at once reversed, so that the length and rapidity of the strokes are entirely under control.

In the second case the returning cylinders are not continually under pressure, but are connected through the piston valve to the steam or exhaust pipe at will.

The most used method of working is the first named, under which condition the press resembles in manipulation and action the steam hammer. The second method of working is more especially used when setting-up is being done.

This press was built and set to work in the beginning of 1898 by Breitfeld, Danek & Co., of Prague, Austria, and since that time has worked with perfect success and entirely answers the purpose for which it was designed.

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.

THE fifty-third annual meeting of the American Association for the Advancement of Science was held in St. Louis during Convocation Week, beginning on December 26, 1903, with an attendance of 385 members. It will be recollected that the first winter meeting of this Association was held in Washington a year ago, with an attendance approaching 1,000 members, and, as is the habit of the Association, the meeting in the East was alternated with one in the West. It was not anticipated that a very large attendance would be had, and therefore it was very gratifying to find that the St. Louis meeting will be fifth in point of numbers of those held during the last ten years. Special stress should be laid upon the fact that the meeting was pre-eminently a strong one so far as the papers were concerned, and while no unusual announcement of great scientific interest was made, still the papers were high in their scientific value. More than twenty affiliated societies held meetings in conjunction with the Association, and the members of these bodies who were not connected with the American Association increased the total attendance of scientists to 466 persons.

The Council received reports of the committees On the Atomic Weight of Thorium; On the Relation of Plants to Climate; On Anthropometric Tests; On Indexing Chemical Literature; On the Velocity of Light; and On the Teaching of Anthropology in America; and the Association adopted the recommendation of the Committee on Grants, making the following appropriations: To the Concilium Bibliographicum of Zurich, $100; to the Committee on the Atomic Weight of Thorium, $100; to the Committee on the Study of the Relations of Plants to Climate, $75; to the Committee on Determination of the Velocity of Light, $75; and to a Committee of Section C, to be appointed, to study certain problems in electrochemistry, $60.

An important recommendation of the standing committee on the relations of the journal Science with the Association, that the Treasurer be added to this committee; that the Vice-Presidents of the Association and the Permanent Secretary be added to the editorial committee of the journal Science, was adopted by the Association.

Owing to the large number of papers presented at this meeting, it will be impossible to more than mention some of the titles.

Section A, which is devoted to mathematics and astronomy, was presided over by Otto H. Tittmann, who is Superintendent of the U. S. Coast and Geodetic Survey. Before that Section there were ten papers, including one on a New Treatment of Volume, by George B. Halsted. G. W. Hough discussed the Rotation Period of the Planet Saturn, while E. L. Larkin described the Facilities for Astronomical Photography in Southern California. This Section also held a joint session with the Astronomical and Astrophysical Society of America, under the presidency of Simon Newcomb, before which eleven papers were presented, including a description by W. W. Campbell, of the Lick Observatory, on the D. O. Mills Expedition; the Sun's Motion Relative to a Group of Faint Stars, by George C. Comstock, of the Yerkes Observatory; and the Absorption of Solar Radiation by the Sun's Atmosphere, by F. W. Very, of the Allegheny Observatory. Also later in the week the Chicago Section of the American Mathematical Society held a joint session with Section A, before which thirteen papers were presented, most of which, however, were of an exceedingly technical character, and typical of which was Group Characters of a Linear Fractional Group; of Linear Homogeneous Groups of Determinant Unity; and of the Group of all Linear Fractional Substitutions in a Galois Field, by H. E. Jordan.

Physics is the special subject to which Section B devotes its attention, and this section had as its President Prof. Edwin H. Hall, of Harvard University. This Section divided its papers under three heads, selecting for the first day's procedings those devoted to optics and electricity. Among the titles may be mentioned a paper by D. B. Grace, of the University of Nebraska, on a Half-shade Elliptical Polarizer and Compensator. This was followed by two papers by John Mills, of Western Reserve University, on the Effect of a Magnetic Field on the Interference of Polarized Light; and the Velocity of Light in a Magnetic Field. Also one by A. D. Cole, of Ohio State University, describing the Hertzian Waves Since the Work of Hertz. A New Method for Quantitative Work in Sound was the title of a paper by John O. Reed, of the University of Michigan; and the Differential Telephone was described by William Duane, of the University of Colorado. Among the papers on heat were Primitive Conditions in the Solar Nebula, by Francis E. Nipher, of Washington University; on the Investigation of the Kinetic Theory of Gases by Elementary Methods, by Henry T. Eddy, of the University of Minnesota; and the Circulation of the Atmosphere as Indicated by the Recent Abnormal Sky Colors, by A. Lawrence Rotch, of the Blue Hill Observatory. In all thirty papers were presented. This Section held on Wednesday a joint session with the American Physical Society, of which A. G. Webster, of Clark University, was President. Thirteen titles were presented, and included such subjects as the Radio-activity of Ordinary Metals, by E. F. Burton, of the University of Toronto; Does the Radioactivity of Radium Depend Upon its Concentration? by E. Rutherford, of McGill University; A Spectrophotometric Study of Fluorescence, by Prof. E. L. Nichols and Ernest Merritt, of Cornell University; the Work of the National Bureau of Standards, by E. B. Rosa, of the National Bureau of Standards; and the Spectrum of the Afterglow of the Spark Discharge in Nitrogen at Low Pressures, and the Spectrum of the Electrodeless Discharge in Nitrogen, both by Percival Lewis, of the University of California. Mention of two papers by John Zeleny, of the University of Minnesota, on the Charges Given to Surfaces by the Diffusion of Ions, and the Earth's Negative Potential; and On the Rate of Propagation of Smell, must also be made.

As in the past, so in St. Louis, Section C, on Chemistry, which was presided over by W. D. Bancroft, of Cornell University, was conspicuous for the large number of papers that were read before it, amounting to nearly forty in number. The American Chemical Society met continuously in joint session with this Section, and the programme contained the titles of papers that were received either by the Secretary of the American Chemical Society or the Section. The striking character of the address by the retiring Vice-President of the Section, Prof. Charles Baskerville, naturally attracted attention to the papers on Phosphorescent Thorium Oxide; on the Action of Radium Compounds on Rare Earth Oxides and the Preparation of Permanently Luminous Preparations by the Mixing of the Former with Powdered Substances; and Action of Ultra-Violet Light on Rare Earth Oxides, which were read by him. An interesting study on the Ripening of Apples was given by W. D. Bigelow, H. C. Gore, and B. J. Howard, of the Department of Agriculture in Washington. Another paper of unusual interest was Dissociation Phenomena of the Alkyl Haloids and of the Monatomic Alcohols, by John Uric Nef, of the University of Chicago. Mrs. Richards, of the Woman's Laboratory of the Massachusetts Institute of Technology, read Thirty Years' Progress in Water Analysis, and Victor Lenher, of the University of Wisconsin, presented Solubility of Gold in Certain Oxidizing Agents. Prof. L. W. Andrews, of the University of Iowa, described his studies on Efflorescent Salts. More technical papers, perhaps, were the Dielectric Constants of Some Inorganic Solvents, by Herman Schlundt; Concentration Cells in Liquid Ammonia, by Hamilton P. Cady; and the Ternary System, Benzine, Acetic Acid, and Water, by A. F. Lincoln; while the Chairman, Prof. W. D. Bancroft, described the Thermometric Analysis of Solid Phases. Of more than common interest was the discussion on Wednesday forenoon of the subject of valence. It began with the presentation of a paper on the Theory of Valence, by G. B. Frankforter, of the University of Minnesota, and was followed by one on the Valence of Double Salts, by James Locke, of the Massachusetts Institute of Technology, after which general discussion took up the remainder of the time, and was participated in by President Remsen, Prof. William A. Noyes, L. W. Andrews, G. Hinrich, and others. It formed one of the most interesting features of the session. As the retiring President of the Association, President Remsen, of the Johns Hopkins University, was a chemist, the Section attended the delivery of his address, and the retiring President of the American Chemical Society, Dr. John H. Long, also delivered an evening address on Some Problems in Fermentation. The usual dinner of the Chemical Society was held on Wednesday evening, at which, in addition to the members of the Society, Prof. E. Rutherford, of McGill University, Montreal, the great authority on radio-activity, was an honored guest.

Section D, on Mechanical Science and Engineering, was presided over by Calvin M. Woodward, of Washington University, St. Louis. Its sessions began with the Vice-Presidential address of Clarence A. Waldo, of Purdue University, who spoke On the Relation between Mathematics and Engineering. Much interest was manifested in the papers read before this Section, owing to the fact that they presented two important general topics which were discussed from many points of view by leading authorities. The first of these had to do with aeronautics, and the papers presented consisted of A Flying Machine Problem, and Practicable Artificial Flight, by J. Burkitt Webb, of Stevens Institute. The Exploration of the Atmosphere as Practised with Kites at the Blue Hill Observatory, Massachusetts, since 1894, and the Aeronautical Concourse at the World's Fair, St. Louis, 1904, by A. Lawrence Rotch, of Blue Hill Meteorological Observatory; the Aeronautical Contests at the World's Fair at St. Louis, 1904, by Calvin M. Woodward, of Washington University; and Aerial Navigation, by Octave Chanute. An evening session was given up to the consideration of the Mississippi River, and the following papers were then presented: The Work of the Mississippi River Commission, by J. A. Ockerson, of the Mississippi River Commission, St. Louis, Missouri; Stream Flow of the Upper Mississippi River, by C. W. Hall, of the University of Minnesota; Levees, Outlets, and Reservoirs, by R. S. Taylor, of the Mississippi River Commission, Fort Wayne, Indiana; A Rational Method of Controlling Floods on the Mississippi River, by Lewis M. Haupt; and the Lower Mississippi River, by James A. Seddon. Other important papers that were read before the Section included the very pertinent one on the Science of Smoke Prevention, by C. H. Benjamin, of Case School of Applied Science. Also of considerable importance, especially as relating to the forthcoming World's Fair at St. Louis, was Recent Improvements at Union Station, St. Louis, by A. P. Greensfelder. In all twenty-five papers were read.

The regretted absence of Israel C. Russell, Vice-President of Section E on Geology and Geography, was ably filled by Charles H. Hitchcock, of Dartmouth College. Only eight papers were presented before the Section, which then adjourned, and members convened with the Geological Society of America, which met on Thursday and Friday, under the presidency of S. F. Emmons, of the U. S. Geological Survey. A detailed account of its proceedings by Dr. E. O. Hovey is given in SUPPLEMENT, No. 1463.

Section F, on Zoology, was presided over by Edward L. Mark, of Harvard University. Titles of thirty-two papers were presented before this Section, and among the more important of these may be included the Albatross Rookeries on Laysan, by C. C. Nutting, of the University of Iowa; on the Analogy Between the Departure from Optimum Conditions and Departure from Geographic Life Centers, by C. C. Adams, of the University of Michigan; A Feature in the Evolution of the Trotting Horse, by F. E. Nipher; Further Observations of the Breeding Habits and on the Function of the Pearl Organs in Several Species of Eventognathi, by Jacob Reighard, of the University of Michigan; the Correlation of Brain-Weight with Other Characters, by Raymond Pearl, of the same institution; Evolution without Mutation, by C. B. Davenport, of the University of Chicago; Studies in Compensatory Regulation, by Charles Zeleny, also of the University of Chicago; Iridescent Feathers, by R. M. Strong; Insect Life Above Timber Line in Colorado and Arizona, by Francis H. Snow, of the University of Kansas; the Types of Limb Structure in the Triassic Ichthyosaurus, and A New Group of Marine Reptiles from the Upper Triassic of California, by John C. Merriam, of the University of California; and the Bermuda Biological Station for Research, by E. L. Mark, of Harvard University. An interesting feature of the proceedings of the followers of this Section was the dinner given to the presiding officer by his former students.

Botany is the topic to which the members of Section G are especially devoted. Owing to illness in his family the retiring President, Frederick V. Coville, Botanist of the U. S. Department of Agriculture, was unable to be present and deliver his address. The Section was presided over, however, by Thomas H. Macbride, of the University of Iowa, and the titles of thirty-nine papers were presented, which were arranged under the topics of Ecology, Mycology, and Morphology and Physiology. The papers on Ecology included the Work of the Year 1903 in Ecology, by H. C. Cowles, which was followed by Notes on the Botany of the Caucasus Mountains, by C. E. Bessey; Ecological Notes on the Island of Bermuda, by S. M. Coulter; Research Methods in Ecology, by F. E. Clements; Plant Formations in the Vicinity of Columbia, Missouri, by Francis Daniels; Distribution of Some Iowa Plants: Formations on Which They Occur, by L. H. Pammel; An Ecologically Aberrant Begonia, by William Trelease; Vegetation of the North Shore of Lake Superior, by C. MacMillan; and the Clothing of an Islet, by C. F. Millspaugh. Under Mycology the following papers were read: The Phylogeny of Lichens, by F. E. Clements; the Necessity of Reform in the Nomenclature of Fungi, by F. S. Earle; the Taxonomic Value of the Spermogonium, by J. C. Arthur; and Fungi Cultivated by Texas Ants, by A. M. Ferguson. Chemical Stimulation of Algæ, by B. E. Livingston; the Histology of Insect Galls, by M. T. Cook; Discoid Pith in Woody Plants, by F. W. Foxworthy; Prothallea of Botrychium obliquum, by H. L. Lyon; and the Dehiscence of Anthers by Apical Pores, by J. A. Harris, were the papers presented under the general heading of Morphology and Physiology. At the close of the presentation of these papers the Botanical Society of America, under the presidency of Charles H. Barnes, convened, and before

it ten papers were read, among which may be mentioned Influence of Carbon Monoxide and Other Gases on Plants, by H. M. Richards and D. T. MacDougal, of the Botanical Gardens of New York; and the Exhibition of Pure Culture Methods in Mushroom Work, by B. M. Duggar.

Section H, on Anthropology, was presided over by Dr. Anita Newcomb McGee, the erudite daughter of Prof. Simon Newcomb, who was called to the chair on account of the absence of M. H. Saville, of the American Museum of Natural History. Owing to the delay in the arrival of the west-bound trains the retiring Vice-President, George A. Dorsey, of the Field Columbian Museum, was unable to deliver his address until two days after the Section had convened. The subject of his paper was on the Future of the Indian, and from his long experience in the Southwest no one was more competent to speak on this topic than himself. The sessions of this Section were held jointly with those of the American Anthropological Society, and in all but nine papers were presented. These included the Department of Anthropology at the World's Fair, and the Knife in Human Development, by W. J. McGee, Chief of the Department of Anthropology at the Louisiana Purchase Exposition, which were presented with demonstrations on the grounds of the Exposition itself. The remaining papers read before the Section were: Presentation of a Ceremonial Flint, and Facts Relative to its Discovery, by H. M. Whelpley; Archeology of the Afton Sulphur Springs, Indian Territory, by R. H. Harper; the Efficiency of Bone and Antler Arrow Points, as Shown by Fractured Human Bones from Staten Island, New York, by George H. Pepper; Certain Rare West Coast Baskets, by H. Newell Wardle; and Stone Graves and Cremation Cists in the Vicinity of St. Louis, by H. Kinner. Subsequent to the delivery of his retiring address, Dr. Dorsey described the Torture Incident of the Cheyenne Sun-Dance of 1903, and gave the History of an Arickaree War Shield.

The sessions of Section I, on Social and Economic Science, have been of considerable interest in recent years, owing to the popular character of the papers presented before them. This Section was presided over by Judge Simeon E. Baldwin, of New Haven, Conn. The practice of grouping the papers under leading topics was also pursued in this Section. The sessions began with the discussion of the address by the retiring Vice-President on Some Recent Phases of the Labor Problem, and was participated in by Lee Meriwether, ex-Commissioner of Labor Statistics, St. Louis; Edward D. Brigham, of the Iowa State Bureau of Labor Statistics, the Hon. Carroll D. Wright, U. S. Labor Commissioner, Rabbi Leon Harrison, of St. Louis, and others. Then taking up the general subject of the Labor Problem, papers were presented on the Relation of the Family to the Labor Problem, by John W. Day; When Labor is King, by Alisan Wilson; and the Application of the Principle of Mutual Insurance to the Prevention of Strikes, by Edward Atkinson. A second general subject for consideration was on the Economic Aspects of the New Agriculture, and on this topic papers were presented on Functions of Forestry in the New Agriculture, by Thomas H. Sherrard, of the Department of Agriculture, Washington, D. C.; Improvement in Farm Management, by W. M. Hays, of the University of Minnesota; the Economic Functions of Live-stock, by Charles F. Curtiss, of Iowa State College; and Agricultural Economics, by H. C. Taylor, of the University of Wisconsin. The status of Instruction in Social and Economic Science in Schools, Colleges, and Universities, was elucidated by papers on High Schools, introduced by Principal W. J. S. Bryan, of St. Louis High School; on Normal Schools, introduced by Henry W. Thurston, of the Chicago Normal School; Colleges, introduced by Robert J. Sprague, of Knox College, Galesburg, Illinois; and Universities, introduced by Frank W. Blackmar, of the University of Kansas, all of which were elaborately discussed by interested speakers. A final session was devoted to the discussion of papers relating to Commerce, Finance, and Government, and under this heading the following papers were presented: Wall Street and the Country, by Charles A. Conant, of Morton Trust Company, New York; Public Purposes for which Taxation is Justifiable, by Frederick N. Judson, of St. Louis, Missouri; Development of Representative Government, by G. H. Shibley, of the Bureau of Economic Research, Washington, D. C.; Services of Commercial Organizations in the Social and Economic Development of Cities, by William F. Saunders, of the Business Men's League, St. Louis; Social Waste, by Ira W. Howerth, of the University of Chicago; and Social Significance of Street Railways, by E. Dana Durand, of the Department of Commerce and Labor, Washington, D. C.

Under the auspices of the American Association a public lecture on the Resources of Our Seas was delivered on Tuesday evening by President David Starr Jordan, of Stanford University, California, and on Wednesday afternoon Prof. E. Rutherford, of McGill University, Montreal, delivered a fascinating address on Radium and Radioactivity, which was fully illustrated and revealed to those present the wonders of the striking phenomena which have so greatly aroused the world of science in recent years. These lectures were complimentary to the citizens of St. Louis. Of decided interest was the visit, by invitation of the officers of the Louisiana Purchase Exposition, to the World's Fair grounds, where the members of the Association and affiliated societies under the guidance of the various heads of the departments visited the buildings of the great city so soon to be opened to illustrate the development of the thirteen States carved out of the territory obtained by the Louisiana Purchase a century ago. If there were any among the visitors who from previous experience doubted the inauguration of this great exposition on time, they left convinced that the enterprise of the officials of the St. Louis World's Fair would inaugurate the new feature of being ready on the opening day. The beauty of the buildings and the grounds only served to increase the desire to visit them again when the glory of their completion could be seen and enjoyed to the fullest extent.

At the meeting of the General Committee it was decided to hold the next meeting in Philadelphia, beginning on Tuesday, December 27, 1904, and closing on Monday, January 2, 1905, and for that meeting the following officers were elected: President, William G. Farlow, of the Botanical Department of Harvard University; Section A, Alexander Ziewet, of the University of Michigan; Section B, William F. Magie, of Princeton University; Section C, Leonard P. Kinnicutt, of the Worcester Polytechnic Institute; Section D, David S. Jacobus, of the Stevens Institute of Technology; Section E, Eugene A. Smith, State Geologist of Alabama; Section F, C. Hart Merriam, of the Biological Survey of the U. S. Department of Agriculture; Section G, B. L. Robinson, Curator of the Herbarium of Harvard University; Section H, Walter Hough, of the Department of Anthropology, U. S. National Museum; Section I, Martin A. Knapp, of the U. S. Interstate Commerce Commission; and Section K, Henry P. Bowditch, of the Harvard Medical School; General Secretary, Charles S. Howe, President of the Case School of Science; and Secretary of the Council, Clarence A. Waldo, of Purdu University.

At the close of the meeting the members adjourned, only to gather again in the evening at the annual banquet of the Missouri Botanical Garden, for which its founder, the late Henry Shaw, left a generous sum of money. This fourteenth dinner was the largest and most brilliant of the series ever given, and to it two hundred guests were invited, the greater portion of whom were members of the Association. The banquet was opened by an address from Chancellor Chaplin, President of the Board of Trustees, and was followed by addresses from the Hon. Carroll D. Wright, Gov. David R. Francis, Henry S. Pritchett, Smith P. Galt, James Fletcher, and Director William Trelease.

STATISTICAL ATLAS OF THE UNITED STATES.

THE Statistical Atlas of the United States which accompanies the report on the Twelfth Census has just been issued at Washington. The work is a very great improvement upon the atlas which was published with the report on the Eleventh Census, both in quality and number of the maps and diagrams, and also in the form of the book, a quarto convenient for handling, while the earlier atlas was an unwieldy folio. The promptness with which it has appeared is also gratifying. It is placed before the public three years after the census year of 1900, while the folio atlas was not published till six years after the census year of 1890.

The topics selected for illustration are confined to population, vital statistics, agriculture, and manufactures; and it is not too high praise to say that no other nation presents these important subjects at once so graphically, so fully and so conveniently for reference as they are shown in this atlas.

The Imperial Statistical Office of Germany publishes many high-class maps illustrating similar facts, but they are not brought together in atlas form; they are scattered through the large volumes issued by that bureau. A map is published in one of the quarterly volumes whenever the data for completing it is obtained. Such maps as we bring together in one volume are thus distributed through a long series of the German publications. The practice we have introduced is time saving.

It cannot be said, however, that all of the maps in the atlas equal many of the official German maps in the completeness of the information presented. The reason is that the collection of data in our far larger field cannot yet include particulars so minute as those which are sought and obtained in Germany. In the five plates of maps and diagrams, for example, which our atlas gives to lumber and timber products, the value and the distribution of these industries are exhaustively shown; but the student will look in vain for any delineation of the areas occupied by the hard wood or soft wood or other forest industries, a very important matter as relating to all the commercial aspects of the sources of supply, the manufacturing and the marketing of these various raw materials. Such information is supplied on the German maps.

The three latest forestry maps issued this year from the Imperial Statistical Office at Berlin show in colors the proportion of the entire area in each German State under forest; the percentage of the forest area in each State covered with deciduous trees; and the percentage of the forest area in each State covered with conifers. Such data are desirable for the mastery of all the essential facts relating to the forest industries; and before many more census years elapse we may certainly expect that they will be presented in our decennial statistical atlas.

Nevertheless, the improvement of the present atlas over its predecessor is nowhere more marked than in the minuter and therefore more thorough presentation of many facts. In the preceding atlas, for example, the unit of comparison of the values of the lumber and timber products in different parts of the country was the State. Minnesota, Wisconsin, and Michigan, the great white pine lumber States, had the darkest tint of color to show the more intensive nature of the industries in those States, and other tints showed the relative intensity in other States; but there was no indication that these industries were confined in many places to comparatively small areas in each State.

The new atlas, however, shows in four tints the value of the lumber and timber products per square mile, so that we are enabled to see the exact degree of intensity of the industries in the exact area where they are situated. This is a great improvement in the direction of more accurate presentation of facts, and it applies to a large number of the map plates in the volume.

Many of the maps are very suggestive. One map, for example, shows the center of the manufacturing industries in the country at each decade from 1850 and also the center of population at each decade. We observe that the centre of manufacturing is constantly far north of the center of population, moving westward through central Pennsylvania and Ohio; while the center of population has moved westward through Maryland, West Virginia and southern Ohio and Indiana, illustrating the predominance of the North over the South in manufactures. The movement westward of the center of manufacturing has been far less rapid than the western movement of the center of population, illustrating the predominance in these industries which the East still holds. In 1900 the center of the manufacturing industries was in central Ohio, a little southeast of Mansfield, while the center of population was near Columbus, in southern Indiana.

It is doubtful if any volume has ever before contained so many maps and diagrams relating to the crops of a nation as this atlas; and yet agriculture is not treated with more fullness than other topics. The following enumeration of the plates given to wheat will illustrate the generally exhaustive treatment given to all the phases of agriculture:

A diagram showing the wheat production in hundreds of millions of bushels in each decade since 1850; a map in five colors showing the production in 1900 per square mile; a map in four colors showing the yield per acre; a diagram showing the production by States in 1900; a map showing the number of bushels per capita in each State; and a map in five colors showing the total production of all grains per square mile of the total area.

Ninety-nine plates give all phases of information relating to the population; twenty-six plates present the facts of vital statistics, including the distribution of diseases; fifty-three plates are devoted to agriculture and twenty-nine to the manufacturing industries. On these twenty-nine plates 178 maps and diagrams appear and the volume includes about 1,200 of these illustrations.

The atlas reflects great credit upon its compiler, Mr. Henry Gannett, the geographer of the census. The maps are fine specimens of the cartographic art, and the volume, for the next ten years, will be invaluable for the study of the human and material aspects of this country.

MANUFACTURE OF ACHROODEXTRIN AND ALCOHOL.

THE object of a process invented by Georges Reynaud, of Paris, relates to the manufacture industrially and under especially favorable conditions of achroodextrin and alcohol. The process consists essentially in soaking the material to be treated in twice its weight of water and in heating the resultant mass under pressure in an autoclave or digester at a temperature of 166 deg. to 220 deg. C. for about an hour and a half. Under the influence of this temperature, the cellulose and amylaceous constituents of the treated materials are converted into dextrin, or more exactly into achroodextrin, which, by reason of its lower density, could advantageously replace ordinary dextrin in its industrial applications. Hitherto achroodextrin has only been known as a laboratory product, because the processes in vogue for the manufacture of dextrin always yield ordinary dextrin, or erythrodextrin. The new process does not necessitate the presence of any acid or other auxiliary substance, is most economical, and obviates the unavoidable defects connected with the employment of acids; the manipulation is convenient and presents no danger. As soon as the conversion of the cellulose and amylaceous constituents into achroodextrin is completed, the aqueous solution is withdrawn from the apparatus and may then be directly employed for industrial exploitation or submitted to a second operation for the purpose of converting it into alcohol. In the latter case, the aqueous solution is heated to 55 deg. C. and a diastase, or pancreatic juice, added to produce saccharification, which is completed in about three hours. The liquid is then caused to ferment by the ordinary means, in employing yeast, care being taken to add two-thirds of 1 per cent of acid; when fermentation ceases the liquid is distilled in the usual way. This small quantity of acid may be introduced into the autoclave at the commencement of operations instead of during fermentation.

Trade Opportunities in Peru.—The sewerage system of the city of Callao, Peru, is to be extended, and will require a large supply of drainage pipes. Government buildings are to be erected in Lima, the Peruvian capital. This will cause a demand for structural iron. The city authorities are also considering the purchase of furnaces for the burning of garbage.—Simon W. Hanauer, Deputy Consul-General, Frankfort, Germany.

[Concluded from SUPPLEMENT No. 1464, page 23462.]

GRAPE, RAISIN, AND WINE PRODUCTION IN THE UNITED STATES.*

By GEORGE C. HUSMANN, Expert in Charge of Viticultural Investigations, Bureau of Plant Industry.

THE RAISIN INDUSTRY.

ORIGIN AND GROWTH.

ALMOST all the raisins of the United States are produced in California. In fact, so few are grown outside of the State that it can be called a California industry. Few branches of horticultural industry in this country have so completely captured the home market as this one.

FIG. 7.—PICKING RAISIN GRAPES IN CALIFORNIA.

The introduction of raisin grapes was really only a part of the introduction of choicer varieties of Viniferas into California. In 1851 Col. A. Harazthy grew Muscatels from the seed of Malaga raisins. On March 25, 1852, he imported the Alexandria (Muscat of), and on September 27, 1861, the Gordo Blanco and Sultana from Spain and the White and Red Corinth from the Crimea. He was the first to introduce raisin varieties into the State. Another importation of Alexandria (Muscat of) was made by A. Delmas in 1855 and planted at San Jose, Cal. G. G. Briggs, of Davisville, imported the Muscatels from Spain, while R. G. Blowers, of Woodland, started the raisin vineyard of Gordo Blanco with cuttings received from Col. Harazthy. These were the first two successful raisin vineyards in the State. Both of these vineyards produced raisins as early as 1867, but it was not until 1873 that their raisin crops cut any figure in the market, when they amounted to nearly 6,000 boxes. In the fall of 1873, 25 acres of Alexandria (Muscat of) were planted in the Eisen vineyards, near Fresno. In 1876 and 1877 T. C. White planted the Raisina vineyard with Gordo Blancos, and in 1877 and 1878 Miss M. F. Austin planted the same variety at the Hedge Row vineyards. Col. William Forsyth interested himself in raisin growing in 1882. From that time on raisin vineyards multiplied so rapidly near Fresno that in 1887 raisin production was recognized to be the leading industry of that neighborhood. In 1873 John North planted Alexandria (Muscat of) at Riverside, and three years later raisin-grape growing had become general there. R. G. Clark planted the first Muscats in El Cajon Valley in 1873, but most of the vineyards of that district were not planted until 1884 to 1886. In Orange County, McPherson Brothers made their first plantings in the seventies near McPherson. The industry grew so that Robert McPherson, the largest grower, became at one time not only the largest packer and dealer in the district, but the largest in the State.

Many changes have occurred since the establishment of the raisin industry in Orange County, and now Fresno has become the center, the conditions there being exceptionally well suited to the growing and the curing of raisins. The raisin-producing section comprises ten counties—Fresno, Kern, Kings, Madera, Merced, Orange, San Bernardino, San Diego, Tulare, and Yolo. The profits from an acre differ materially, varying from $50 to $500, a fair average being from $125 to $150. It takes from three to four pounds of grapes to make one pound of raisins. The product of about 65,000 acres is at present converted into raisins, it being desired to cure only enough to meet the demand. The demand for the last five years has been about eighty million pounds, or only one pound per capita for the United States.

CULTURAL CONDITIONS.

In the raisin-producing section of California the country is so level naturally that not much leveling is necessary. The soil varies considerably, the deep gray alluvial bottom land being considered the best for Muscatel grapes. The pruning, planting, and cultivating of a raisin vineyard is much the same as in other California vineyards.

Crops can be grown without irrigation, but it is practised because it increases the size of the fruit, and therefore increases the yield. Two irrigations are necessary, one early in the summer and another when the berries begin to ripen. Before irrigation was so extensively practised, water was usually found at a depth of about 18 feet; now much trouble is experienced in some localities on account of the lands becoming water-logged. In the hottest time of the summer the thermometer has stood as high as 114 deg. F. in the shade for a day or two at a time. The highest average is about 90 deg. F., while the average in July and August is about 85 deg. F. in the shade. The nights are always much cooler than the days. The coldest weather in winter is 18 deg. F. above zero. The summers are rainless and the nights are so free from dew or moisture that a piece of tissue paper after lying all night is crisp and stiff the next morning, without a particle of moisture showing. The rainfall averages 13 inches. The principal rains occur in January and February, with some showers in October. Frequently it rains enough in November to cause considerable damage to partially dried raisins and grapes. It is then that the Japanese laborers watch the predictions of the Weather Bureau, and when rain is indicated ask as high as 50 and 75 cents an hour for turning and covering the trays of raisins that are out in the vineyards. So familiar has this practice become that the school children who are large enough get excused from school for the work. In fact, the labor question is one of the most serious problems the growers have to contend with. The Chinese and Japanese laborers (especially the Japanese) control the situation, and make from $2 to $3.50 and even as high as $4 per day picking grapes. (Fig. 7.)

HARVESTING AND PREPARING THE CROP.

Grapes are ripe by the middle of August, the season often lasting into November. The average time of drying and curing a tray of raisins is about three weeks, all depending on the weather. The earliest picked grapes dry in ten days, and the later ones often take four weeks and even more. The method of drying is very simple. The bunches are cut from the vines and placed on shallow trays (Fig. 8) 2 feet wide, 3 feet long, and 1 inch high, on which the grapes are allowed to sun-dry, being turned from time to time by simply placing an empty tray top side down on the full one, then turning both over, and taking off the top tray. After the raisins are dried they are stored away in the sweat boxes until they are packed and prepared for shipment. Some of the larger growers, in order not to run so much risk in drying on account of rain, and also to enable them to handle the crop fast enough, have curing houses, where the curing is finished after having been partially done outside. The seeding, grading, packing, and shipping have become separate branches. In the season of 1898 and 1899 sixty plants were engaged in this part of the work, the most of them located in the Fresno district. These establishments furnished employment for 5,000 employes, and the aggregate wages paid out to them each month during the season was nearly $250,000.

EXPORTS, PRODUCTION, AND IMPORTS.

The exports of California raisins first became of sufficient importance to be separately stated in the official reports of the Treasury Department in the fiscal year ending June 30, 1892. Raisins have since been sent in small, it may be said experimental, quantities to all parts of the world, and the trade has grown until in 1898 the exports amounted to 3,109,639 pounds and in 1902 to 2,323,274 pounds.

The following figures serve to show how gradually and systematically California has monopolized the raisin trade of this country:

Raisins Produced and Imported.

Year.	Raisins produced. Pounds.	Raisins imported. Pounds.
1885	9,400,000	53,702,220
1890	38,000,000	36,914,330
1895	91,360,000	15,921,278
1898	80,631,000	6,593,833
1902	100,000,000	6,563,302

The year 1894 was the record breaker, when 103 million pounds were produced. Raisin growers claim that this was made possible by the duty of 2 cents a pound on imported raisins. Consul Ridgely says, so cheaply and abundantly are raisins grown in Malaga, that were it not for the duty Malaga exporters would undoubtedly undersell California growers. The season's opening prices for raisins the last four years have been: Per box of 20 pounds—Imperial clusters, 6 crown, $2.50 to $3; Dehesa, 5 crown, $2 to $2.50; Fancy, 4 crown, $1.50 to $3; London Layers, 3 crown, $1.20 to $1.60. Per pound in 50-pound box or bag—loose Muscatels, 4 crown, 4¾ to 7 cents; loose Muscatels, 3 crown, 4 to 6½ cents; loose Muscatels, 2 crown, 2¾ to 6 cents; seedless Muscatels, 3¼ to 6½ cents.

FIG. 8.—DRYING SEEDLESS RAISINS IN CALIFORNIA.

WINE, BRANDY, AND CHAMPAGNE MANUFACTURE.

The manufacture of each of these products from grapes constitutes an imporant industry in itself, and can not be described in this paper. According to the United States census for 1900, of the 179,055 gallons of sparkling wines manufactured, California reported 8,880; Ohio, 15,600; Missouri, 2,940; and New York, 113,435 gallons. This shows that New York produced

* From Year Book of Department of Agriculture.

more than twice as much as all the other States together.

The yearly production of wine from 1887 to 1891 in California was from 15 million to 20 million gallons, and the price fell below 10 cents a gallon, notwithstanding the fact that the demand had increased a million gallons annually; notwithstanding also that half a million gallons of brandy had been made in 1886, with the same amount in 1887, and, in the three years next succeeding, a million gallons annually; that in the southern part of the State 20,000 acres had been destroyed by the Anaheim disease; that in Napa and Sonoma counties the bulk of the vineyards were wholly or partially destroyed by the Phylloxera, and that about 600 carloads of dried grapes had been shipped in 1889 and 1891. The state of affairs then existing can hardly be imagined. Many growers became bankrupt; those who had sufficient means pulled up their vines and planted other fruits or raised hay and grain; a few, who believed in the ultimate success of the industry, persevered, and replanted the vineyards which the Phylloxera had destroyed. In 1892 the heavy frost which prevailed over the leading wine districts cut the crop down to 15 million gallons, and prices went up. About this time the California Wine Association was formed for mutual protection by the largest dealers. In 1894 the California Wine Makers' Corporation was organized by the wine makers of the State for a similar purpose, and set the price in wholesale lots to the dealers at 15 cents. The corporation, which had secured enough of the State's output to control prices, entered into a contract by which an association of the principal dealers agreed to purchase from the corporation 5 million gallons annually. All went well until some of the producers became dealers and undersold the association. This resulted in a rupture of the two associations. At the next annual meeting of the members of the Wine Makers' Corporation its board of directors was instructed to enter the markets of the world. A long war of cutting prices for standard wines was the result, which was embittered by the phenomenal yield of 1897 of 27 million gallons dry and 7 million gallons sweet wine, and prices again became low. The next season witnessed a great shortage in crop, only 18½ million gallons of both dry and sweet wines being produced. This led to better feeling between the factions, and brought about higher prices. Commercial statistics show that the trade requires 22 million gallons yearly—16 millions for export and 6 millions for coast consumption, 4 millions of this being sweet wine. The demand is increasing by 2 million gallons annually, so there is a shortage instead of overproduction, and the wines of 1900 changed hands at from 15 to 20 cents in wholesale lots from producer to dealer. The 1901 crop brought from 20 to 35 cents a gallon, and the price for the 1902 crop will be about the same.

The following prices of grapes for the last season will serve to illustrate the difference existing in the quality of grapes for wine-making purposes: In the Napa district, $30 to $35 per ton; Sonoma, $22.50 to $30; Santa Clara, $25; Livermore, black grapes $20, white $30; Contra Costa and Alameda, $25; south of the Tehachipi, from $12.50 to $15.

The investment of capital in the California wine industry may be summed up as follows:

Vineyards, at $200 an acre	$38,000,000
Nearly 500 registered distilleries..	200,000
About 40,000,000 gallons cooperage.	14,000,000
Cellars and machinery	10,000,000
Capital to carry on business......	10,000,000
Total	$72,200,000

This industry, which is not much more than fifty years old, gives employment to nearly 60,000 persons.

SOME OF THE LARGE VINEYARDS OF CALIFORNIA.

To the late Senator Leland Stanford, founder of the Leland Stanford Junior University, belongs the distinction of having had the largest vineyard in the world, comprising nearly 5,000 acres, and being over 7 miles long. The wineries on the place cover more than 6 acres of roof surface, and during the years the writer had charge of them from 2½ million to 3 million gallons of wine were made annually, from 400 to 850 tons of grapes being crushed daily.

At Asti the Italian-Swiss colony has 1,700 acres in bearing vineyards. On the place are extensive wineries, with the largest wine vat of the world, holding 500,000 gallons.

Near Cucamonga the Italian Vineyard Company has, during the last three years, planted nearly 2,000 acres in one field. The Riverside Vineyard Company during the same time planted 2,500 acres in one vineyard.

The California Wine Association, at its own wineries, in 1902, worked up 150,000 tons of grapes and at its leased wineries enough more to make 225,000 tons. In the fall of 1902 the association paid out in cash over $5,000,000 for grapes. Throughout the State there are quite a number of vineyards of 500 acres each.

SOME SUCCESSES AND REVERSES.

New York being the leading State for the growing of American grapes and California for the Vinifera varieties, a brief review of the conditions and prices that have prevailed in those States will give a fair insight into the past history of the industry.

In New York thirty years ago 5 and 6 cents a pound were received for grapes. In 1889 the price per pound for basket lots was 3 cents, in 1893 about 1 1-3 cents, in 1898, 1899, and 1900 about three-fourths of a cent, and in 1901 about 1½ cents. In 1890 and 1891 bulk grapes brought an average of $20 a ton, and in 1892 an average of $18 per ton. From that time the price gradually diminished until 1896, when the average was no more than $9 a ton, and one particular lot of 100 tons was sold for $4 per ton. Since then the average price has been about $12 a ton until 1901. For some years the price of grapes failed to pay expenses of growing. The cultivation, or rather the care, of the vineyards had ceased to be a labor of love and had become one of necessity. The question was, Will the vineyards pay expenses then? In order to make them do so the vines were overcropped, expenses were curtailed, and each grower tried to do as much of the work as possible himself. Much of the work was carelessly done, much was left undone, and much was done at the wrong time, resulting in injury to the vines from which they will never entirely recover. Such were the conditions at the beginning of the 1901 vintage, when, on account of the great shortage of the grape crop in other sections and a short crop of other fruits, especially apples, with a lively demand for unfermented grape juice* and cheap clarets, grapes were in great demand and much better prices were realized than for six years previous.

In California, in 1876, Mission grapes sold for from $7.50 to $10 per ton and other varieties from $14 to $18 per ton, so that many growers having poor shipping facilities turned hogs in to harvest the crop. In 1879 Mission grapes brought $10 to $12 and choice varieties $20 to $25 per ton. Prices then went up rapidly, and from 1880 to 1882 Mission grapes sold at from $15 to $20 per ton. The extreme prices had indeed been reached, and those growing grapes became rich in a few years. Everybody who could possibly plant an acre of vineyard did so, and in a few years the production far exceeded the demand, when prices dropped until in 1886 grapes brought only from $6 to $10 per ton.

After years of successes and reverses, shortages and overproductions, the industry in the East and West has gradually settled down to a more solid business basis. Grafting stocks are in good demand, the prices of grapes and wines are steadily increasing, and much new area is being planted in vines. The new plantings the last few years have been exceedingly large, and there is every indication that they will be even larger. It is to be regretted that in California, where so many thousands of acres have already been destroyed by the Phylloxera, many of those making new plantings are not using resistant stocks, and therefore many of the vineyards will not live long enough to bear a crop. In California, and the eastern section of the country as well, due regard is not being paid to the selection of the proper varieties of fruiting sorts, and returns will be diminished accordingly. This is especially to be regretted, for not only should growers, profiting by past experience, avoid errors previously made, but also improve methods wherever possible.

FUTURE OF THE INDUSTRIES.

Looking back to the middle of the last century, when just a start had been made, when growers were beginning to believe something might perhaps be done in the way of a commercial grape industry, and taking a glance at what such States as Virginia, Missouri, Ohio, New York, and California have done, especially New York and California, there is good reason to believe that the industry in this country may yet reach a development proportionate to that of other agricultural interests. Achievements at expositions and on public occasions, however, are really far in advance of what has been done in the way of production. This may be easily seen when the product of this country is compared with that of other countries. In 1901 France produced of wines 1,523,233,200 gallons; Italy, 1,013,760,000; Spain, 520,080,000; Portugal, 155,760,000; Austria, 116,160,000; Roumania, 87,120,000; Chile, 85,120,000; Russia, 76,560,000; Bulgaria, 73,920,000; Germany, 60,720,000; Argentina, 55,440,000; Turkey, 50,160,000; Greece, 32,300,000; Switzerland, 31,680,000; United States, 29,500,000, and Servia, 23,760,000 gallons. However, the industry in the United States is as yet in its infancy. A beginning has just been made in a commercial and businesslike manner to improve the methods and expand markets. California has produced and sold annually the last ten years an average of 20 million gallons of wine, 2 million gallons of brandy, and 80 million pounds of raisins.

So far the raisin industry of this country has only supplied the small home demand of 80 million pounds, whereas the present population, were it to consume as much per capita as some other countries, say Great Britain, would now use 400 million pounds annually, not to say anything of extending the markets and exporting to other countries.

When it is considered that France in 1901 produced 1,523,233,200 gallons of wine, while this country produced 29,500,000 gallons, and that the Golden State alone has a grape and wine producing area almost equal to the whole of France, some idea can be formed of the great possibilities of the industry.

A beginning has been made; what the industry will be remains largely with those who engage in it. No reason presents itself why varieties of grapes should not be cultivated wherever the wild vines flourish,

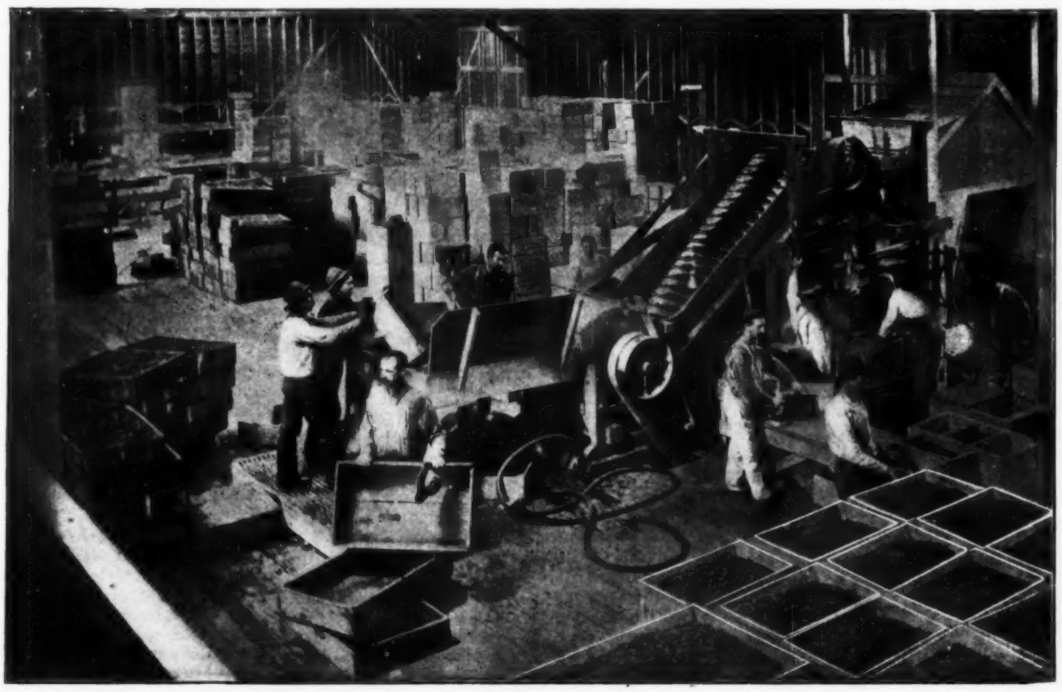


FIG. 9.—STEMMING RAISINS IN CALIFORNIA.

* The manufacture of unfermented grape juice is already a considerable industry, and is rapidly increasing. See Bulletin No. 24, Bureau of Plant Industry, U. S. D pt. Agr.

and some of these are found in nearly all parts of the Union.

Two important lines of work need thorough experimental investigation in the near future. One of these is the determination of the relative adaptability of resistant stocks to the various types of soil found in the commercial grape regions of the Pacific coast and of the congeniality of the leading commercial varieties of the Vinifera type to such stocks. The other is the development of varieties suitable for those districts east of the Rocky Mountains in which the native grapes that have developed in New England, New York, and other northern districts are not adapted to the climatic conditions. The field which is in special need of such varieties includes the South Atlantic and Gulf States. With the wealth of native grapes in this region and the improvement of the grape already accomplished through hybridizing, it appears almost certain that varieties of choice quality, resistant to the fungous diseases that prey upon the Vinifera and Labrusca types in the South, may be developed, and in the not distant future make grape culture as remunerative and certain in its results in this region as it already is in other portions of the country.

[Concluded from SUPPLEMENT No. 1464, page 23464.]

UNIVERSITIES: THEIR AIMS, DUTIES, AND IDEALS.*

BRANCHES OF KNOWLEDGE, SUBJECTIVE TO MAN.

HAVING now expounded this opinion as frankly as is consistent with the brevity imposed upon me by circumstances, I pass to a review of other activities of the university which usually do not give rise to contentious difficulties. As a beginning must be made somewhere, let us begin with man. We may regard him as engaged in the conduct of his own existence, possessed of mental faculties, directed by certain tastes, exercising mental activities, standing (either as an individual or as one of a group) in multifarious relations with other men; he is placed amid a universe, and there are the phenomena of that universe, living or inert, outside him. Each of these qualities, if they may be so styled, gives rise to a branch or to several branches of knowledge.

Our first quality of man as an existing being has regard to his conceptions of the general nature of knowledge and existence as such, and to the theory of his conduct of his own existence; the branches of knowledge related to those conceptions and that conduct are most simply described by the titles of metaphysics and of moral philosophy or ethics.

His next quality pictured him as possessed of mental faculties. The range of these faculties, their detailed activities, their modes and methods of working, to mention only some of their features, give rise to the branches of knowledge described by the titles of psychology and logic. In theory, there are close relations between logic and mathematics; in practice, particularly the older practice, mathematics as a subject has usually been derived from the study of nature.

Man then was indicated as directed by certain tastes; in this indication, it is mainly his æsthetic faculty that is contemplated. The branches of knowledge associated with the æsthetic element in man are conveniently summarized in the title of the fine arts, meaning thereby the arts of music, architecture, sculpture, and painting, alike in their industrial and their intellectual aspects.

When we contemplate the quality of man as connected with the exercise of his mental activities, not in the mode of the exercise but in its results, we are practically face to face with the intellectual creations of all individuals in the aggregate. The section of knowledge which thus arises is so vast that there is difficulty in finding a single title to describe it. Taking account of such limitations upon the range of this knowledge as are implied in the other activities of man which have been explicitly recited, I shall perhaps most simply describe it as literature.

When we contemplate the quality of man as standing in relations with other men, either as an individual with other individuals, or as a member of a community with other communities, or as a citizen of a state with other states, the branches of knowledge arising through these relations are languages, law, economics, and history.

Thus far, every branch of knowledge indicated has arisen through the consideration of qualities directly appertaining to the individual man, either to himself alone or in association with others. But his circumstances have to be considered. He is placed in a universe, and before there can be any real approximation to a fit understanding of man and his surroundings, the phenomena of the universe must be studied in their facts, their laws, their orders, their significance, their influence. These studies are vast and varied; they are concerned with all the knowable relations of nature, alike animate and inanimate, and they give rise to that immense and ever-increasing ordered body of knowledge usually called science in general. It includes all the particular sciences, and these may be ranged broadly in the three classes of mathematical sciences, physical sciences, and biological sciences, the first two of which have closer relations with one another than (as yet) either with the third.

RAMIFICATION OF STUDIES.

Provision has to be made for the adequate teaching of all these branches of knowledge, and it will be seen that my ideal university is growing at an alarmingly rapid rate. Yet the growth will have to be much greater, in respect even to these branches of knowledge, than the statement can outline, exacting as it seems. Branches of study have been indicated as originating mainly in some one source or other, but any study, once definitely introduced into an ordered scheme of knowledge, may develop into issues vastly wider than its initial purpose. Examples occur at every turn. Languages arose in my enumeration through the relations between man and man; presumably, therefore, they arose for their use in oral communication. But they can be studied for other than utilitarian purposes. They may be studied organically, that is, for their accidence, their syntax, the sources of their words, the analogies and the differences in their methods, their growth and their mutations, their influence upon one another; these, and similar aspects of languages, constitute the science of philology, and provision will have to be made for its teaching. Further, I would make the mild remark that languages, ancient and modern, are the vehicle of literature in the widest meaning that can be given to the word, and a mode of teaching them, which is neither utilitarian (in my sense) nor philological, will be required for appreciation of the best treasures of thought, for comprehension of the records of development of nations, for intelligent understanding of the civilizations of the world.

As for languages, so for history, another of the subjects that in my enumeration arose through the relations between man and man. It may begin in our scheme as the record of the doings of particular peoples; it must develop into the history of mankind to which that of particular people is ancillary. The history made up of acts is not more important, rather it is less important, than the history of movements and the development of political thought. Account must also be taken of the fine arts, moral philosophy, religious thought, scientific thought, in that continuous succession which also is their history. For all these, and for the corresponding amplifications of other branches of knowledge introduced initially in the simplest of elementary demands, provision must be made in the university.

OTHER BRANCHES OF KNOWLEDGE.

When all this is recognized, and when all the demands thus made are acknowledged and met, then it might be imagined that the necessary provision of the university is complete and that she is fully equipped to discharge all her duties. Far from this being her happy reality, she must afford opportunities for another group of classes of knowledge of an entirely different kind. In the gradual elaboration of the scheme, many useful branches of knowledge have been established; yet in their inception they have been established rather as pure knowledge, and they do not attain their full significance until they have been so organized that the amplest utilitarian tax has been levied on their riches. There thus must be (to use the ancient word) a faculty of theology, a faculty of law, a faculty of medicine and surgery; though just as not all theology can be taught in the one faculty, for dogmatics have been excluded, so neither all the practice of law nor all the clinical elements of medicine and surgery can be taught in their respective faculties in the university.

Nor is this all. These practical organizations have been selected as being subjective to man, but they are not complete even within that categorical limit. Growing academic thought has discovered that other organizations of knowledge can fitly be framed; Birmingham now possesses a department of commerce, Cambridge has just established a new curriculum in economics, and not in one university alone has provision been made to meet a growing sense of the need for a department in the history, the theory, and the art, of education itself.

The tale of demands is not yet full. Only those branches of useful knowledge have thus far in the scheme been selected for utilitarian organization which are most closely associated with man's health and man's human relations. There still remain those other branches of useful knowledge which, fitly organized and selected, will train men to wield the forces of nature for the advantage of the community. Perhaps the most conspicuous example of such a group of branches of knowledge is provided by the school of engineering which certainly must exist in our ideal university, to include instruction in electrical engineering, in mechanical engineering, and in naval engineering; and other examples, following the wisdom of recent establishments, will be given by a school of agriculture, a school of tropical diseases, and departments of particular industries depending largely upon the locality of the university. It lies with the future gradually to work out the balance between practice and training, and to settle the proportion between experiment and experience, in the equipment for professions of the newer order as has been done for the professions of medicine and surgery. And let me add two warnings. While the earlier stages in any such process continue, there is more than a probability that old ideas as to what constitutes a university education will receive rather rude shocks, and may occasionally be staggered. I would, very respectfully, urge a caution against the exclusion of any subject of new technical knowledge from the university, either actual or ideal, if only because no man can foretell its possible tribute to even abstract theories; I would suggest that its prudent reception in a not too unsympathetic spirit is a preferable mode of exercising the caution of academic wisdom. On the other side, the fiery and occasionally arrogant advocates of devotion to the newest learning would do well to temper their vehemence with intellectual charity. Before they came upon the scene, thought had propounded problems which their sciences cannot touch; after they shall have left it, thought will continue to propound problems equally unamenable to their sciences.

EXTENSION OF KNOWLEDGE: RESEARCH.

Hitherto, I have spoken of the university as a treasury of all ascertained knowledge which is to be given without stint to all qualified students coming for its wealth, and those who distribute this wealth are the professors and other teachers. But that duty, no matter how excellently discharged, is not the sole duty of these officers in respect of knowledge; if it were, the university would only be a rather glorified secondary school. It is true that we have not supposed our ranges of study to be confined to antique knowledge which is crystallized; on the contrary, all knowledge is to find its home in our university and, at the fitting stage, the students will be brought into contact with living knowledge, growing, increasing, and in its very vitality proving the greatest stimulus to the ardent mind. You would not be content that the estimates of literature should only be those of some bygone generation. The last word in judgment of painters and painting had not been uttered when Ruskin finished his great book. Almost from day to day, a chapter in the history of civilization anterior to the Greeks is being opened up by the discoveries in Crete. Not all the problems of history are solved, and their solution will add to the knowledge of the past, perhaps to the comprehension of the present. After the past week, you will not need to be told in detail how, in every direction, the sciences, abstract, concrete, practical, are advancing by leaps and bounds. Progress is the condition, it is the essence, of living knowledge; it should be the very breath of life of the university.

How is this progress to be secured, and the knowledge of it made available? It is manifestly the duty of the professors to assimilate new facts as they come, and to submit them to those critical refining and concentrating processes which make the surviving product some contribution to truth. But is there to be nothing else on the part of the professors? Is it to be "all take and no give?" all absorption and no production? Are they to profit by taking toll of all the thought of the world, and to contribute nothing for toll in return? I hold it to be the highest duty of a teaching professor that, up to the limits of his powers, he should strive to contribute to the increase of knowledge and the advancement of truth.

Now I know that all professorial spirit is not the same spirit. There is a spirit which devotes itself to administration; its works deserve grateful acknowledgment, and they are undoubtedly indued with the exercise of power, so dear to many souls. There is a spirit which devotes itself to the humanizing and social influences that should be a feature in the life of a university; its labors are blest in a quickened vitality that affects the whole community. But the spirit of research must also be there; not alone the quest of facts, but the quest of truth, which is higher than facts; not alone the love of novel thought, but the love of wisdom, which is the crown of thought. You cannot secure it by regulations; a professor will devote himself to research in proportion as he likes it, not because it is an expected duty. You cannot exact it from every professor; but there must be a substantial amount of research produced by the aggregate of professors, or their corporation will fail to contribute its share to the advancement of learning. Moreover, in the absence of research, the university will fail in other respects, for it will be unable to exercise the profoundest of all influences upon the most earnest of its students whose later duty it will be to carry on the torch of learning—I mean the influence of stimulus and inspiration.

Will you let me be reminiscent for a few moments? When I was an undergraduate at Cambridge studying mathematics in all the earnest and kindly rivalry that is frankly and easily possible among young men who are friends, there was, among the professors, a group of four men of supreme eminence, Stokes, Cayley, Adams, and Maxwell. We were not (or thought we were not) sufficiently qualified by our attainments to attend their lectures in our earliest days; but our teachers could tell us of their powers, their genius, something of what they had done or were doing, and we knew that they stood among the great men of the world. Do you think it was a little thing to young men at the opening of life that they belonged to a university which possessed such illustrious pioneers of learning? I can tell you that, though the young men then knew themselves hardly worthy of entrance even into the court of the Gentiles in the temple of new knowledge, the mere presence of the great men stimulated them and inspired them along the paths which led to the temple. I have spoken of one group of professors, great men in the domain of knowledge that was our special pursuit; I would mention another group of professors possessed by Cambridge at that time equally great in another domain, that of theology. They were Lightfoot, Westcott, Hort. To theological students I suppose that they stood for as much as did the mathematical group to us; but even to those of us who were not theological students their achievements made the university a more stimulating home of study, though we knew nothing in detail of their work. All these men are dead, the oldest of them all only a few months ago; their bodies are buried in peace, but their names live for evermore, a treasured inheritance and the proud possession of the university of which during their lives they were an ornament, a glory, and an inspiration.

This deviation into personal reminiscence is undoubtedly an interruption of my main line of argument. Yet these particular examples of fact may show more than any ordered sequence of reasons could do it

* Part of an address to the Southport Literary and Philosophical Society, delivered on September 17 by Prof. A. R. Forsyth, F.R.S.

the establishment of my contention that a healthy university must contribute not merely to the diffusion of knowledge, but also to the advancement of learning.

CONCLUDING REMARKS.

I have spoken at length of some of the aspects of universities, and have incidentally alluded to others, and some have been omitted entirely. It is time, however, that my remarks should draw to a close, and so I leave the subject with you at this stage. Earlier in the evening I confessed that the receipt of the charters of the universities of Manchester and Liverpool suggested my subject. But the real reason for its selection was a desire on my part to do something by way of concentrating your thoughts, and, through you, the thoughts of others, upon the significance of university education, for I believe that a vigorous university can exercise a most beneficent influence upon the life of a nation. It certainly can play its part in so training men that they can contribute to the commercial success and the material welfare of the people among whom it is placed. But it can do more. The greatness of a people is not to be measured solely or even mainly by its commercial success, or the extent of its empire, or the vigor of its fighting powers. Thought has its part in life, no less than action; frequently it dominates action; often it is more potent than action in its influence upon the course of civilization. In estimating the position of a nation in the scale of the world, not a little weight ultimately is attached to its devotion to learning. The spread of learning makes for the clearer understanding of the nations by one another, and consequently assists toward developing feelings of comity and invoking the spirit of peace. Universities can do much as agents in the achievement of these aims as of others that are more utilitarian. They give to their people a wider range of knowledge and a higher standard of culture, and they can organize the genius and the ability of a nation so as to feed the living springs of action and enable it to make no unworthy contribution to the growing thought of the world.

[Continued from SUPPLEMENT No. 1464, page 23459.]

GRANTS MADE BY THE CARNEGIE INSTITUTION.

BIBLIOGRAPHY.

ROBERT FLETCHER, Army Medical Museum, Washington, D. C. For preparing and publishing the "Index Medicus." $10,000.

The "Index Medicus" was established in 1879, under the direction of Dr. John S. Billings and Dr. Robert Fletcher, and discontinued in 1899, after twenty-one volumes had appeared, for the lack of pecuniary support.

Abstract of Report.—The scope of this work is very broad with relation to the medical sciences. It contains, in classified form, month by month, reference to everything published throughout the world which relates to medicine or public hygiene. The latter comprises all that concerns the public health in its municipal, national, and international relations.

Nine numbers of the volume have been issued, and the volume will be complete with the January number, when the "annual index" will be compiled. The index is a very elaborate piece of work, and will comprise 200 pages in double or triple columns. The work is of great value to all the medical profession, especially to professors in medical schools and colleges, officers of health, and workers in scientific laboratories.

The subscribers to the "Index Medicus" are chiefly residents of the United States, but the list includes subscribers in England, Ireland, Scotland, Canada, Australia, France, Germany, Spain, Portugal, Roumania, Sweden, Switzerland, and Manila. There are now 455 subscribers.

HERBERT PUTNAM, Librarian of Congress, Washington, D. C. For preparing and publishing a "Handbook of Learned Societies." $5,000.

In order that the scientific investigators of this country, and especially those connected with the Carnegie Institution, might have an accurate knowledge of the agencies which now exist for the promotion of scientific inquiry in every part of the world, the advisory committee on bibliography recommended that a descriptive catalogue be prepared of all the learned societies of the world.

At the present time such information, and particularly regarding the publications of learned societies, is incomplete and unorganized, being scattered through a large and miscellaneous collection of volumes, many of which are inaccessible and not well known. A careful and comprehensive list would be of great value to all the librarians of the country who aim at the preservation of the transactions of learned bodies. It would also furnish a basis for exchanges. The funds for research work held by these various institutions have special significance with reference to the activities of the Carnegie Institution. The plan of the handbook included information as to these eleven points: (1) name or names of the society or institution, indicating any change which may have occurred, with cross references; (2) objects of the society; (3) brief historical note; (4) endowments, research funds, prizes, etc.; (5) officers of the society; (6) membership, numbers, conditions and manner of election, dues, etc.; (7) meetings—their character, frequency, time and place; (8) communications—regulations for presentation and publication of papers; (9) list of officers, with address of corresponding secretary; (10) complete and detailed bibliography of all regular or special publications since the foundation of the society, editions (how large?) to satisfy all the above mentioned requirements; (11) publications—conditions and methods of distribution; prices.

According to the plan of work approved, the handbook is to be in volumes; societies to be classified by subjects, with local arrangement, and each class to constitute a separate part. The following order of procedure has been adopted: (a) To prepare a list of societies from the exchange lists at the Smithsonian Institution and elsewhere in Washington, and a card catalogue to keep orderly record of communications; (b) to issue a suitable circular to these societies, requesting the desired information; (c) to prepare for publication the material received, filling out lacunæ by further correspondence and reference to various sources of information; (d) in the case of societies not replying to circular or letter, and in regard to which sufficient information can not be obtained from printed sources, to adopt such other methods as the progress of the work may suggest.

The first stage of this work was the preparing of a card catalogue of names of learned societies and institutions. Every source of information known and available in the Congressional Library was searched to make this as nearly complete as possible, at the same time separating (1) dead societies and (2) societies not publishing any material of importance to investigators.

The second stage of the work was the sending of a circular letter, containing an outline of the information required, to academies and societies dealing with historical and social science in Europe and North America. Russia and other Slavic countries, and also Austria and Hungary, are being treated independently, advantage being taken of a visit to Russia by Mr. A. V. Babine, of the Library of Congress. Mr. Thompson and Mrs. Thompson made personal visits to England, Paris, Belgium, Holland, and Berlin for the purpose of supplementing the information obtained by correspondence. It is anticipated that Mr. Thompson will also visit Italy and Switzerland.

The third stage of the work, the reduction of the replies received to standard form, was begun in August, and is now going on in the office at Washington. It is expected that this work will be brought to completion in 1904.

BOTANY.

W. A. CANNON, New York Botanical Garden, N. Y. For investigation of plant hybrids. $500.

Abstract of Report.—Under this grant Mr. Cannon worked at the New York Botanical Garden until September 1, 1903. He prepared a paper on the spermatogenesis of the hybrid peas and collected material for the study of the sporogenesis of two fern hybrids.

H. S. CONARD, University of Pennsylvania, Philadelphia. For study of types of water-lilies in European herbaria. $300.

Abstract of Report.—The grant made to Mr. Conard was to enable him to examine the types of water-lilies in various European herbaria for the purpose of completing a memoir on water-lilies which the Carnegie Institution is about to publish. He was successful in obtaining the requisite data, and the memoir will soon go to press.

DESERT BOTANICAL LABORATORY (F. V. Coville and D. T. MacDougal, Washington, D. C.). $8,000.

At the meeting of the trustees in November, 1902, a comprehensive plan for the encouragement of botanical researches was submitted by the advisory committee on botany (see "Year Book," No. 1, pages 3-12).

In carrying out this plan, Mr. F. V. Coville, botanist of the Department of Agriculture, Washington, and Mr. D. T. MacDougal, director of the laboratories of the New York Botanical Garden, were requested to go to the arid lands of the West and make such further recommendations as might seem to them best. They became persuaded that the best position for the laboratory, considering both natural and artificial advantages, is Tucson, Arizona, and they recommended its establishment there and the engagement of Dr. W. A. Cannon to be resident investigator.

A full report with respect to the organization of this laboratory and of the various circumstances which led up to it will be published in a monograph soon to be printed among the publications of the Carnegie Institution.

Abstract of Report.—Messrs. Coville and MacDougal were appointed a committee on the subject of a desert botanical laboratory.

After their visit to the principal points in the southwestern desert region, a laboratory location was selected near Tucson, Arizona.

The building site, water supply, road and electrical connection were presented by the Chamber of Commerce of Tucson, the cash value of these concessions amounting to about $1,400, and the discussions that took place initiating what is still more valuable—the hearty interest and co-operation of the citizens in the purposes of the laboratory.

A laboratory building has been planned, contracted for and completed, the contract price being $3,843. The laboratory has been equipped with books, apparatus, furniture, and supplies, at a cost of $1,813.50.

Dr. W. A. Cannon, recently connected with the New York Botanical Garden (Bronx Park), New York, was appointed resident investigator, and took charge of the laboratory September 1. He is now engaged in investigating the root systems of desert plants with reference to their special devices for the absorption and storage of water.

The privileges of the laboratory have been granted to Prof. Charles B. Davenport University of Chicago, for an inquiry into the morphological and physiological adjustment of desert animals to their habitat. Other applications are pending.

The committee has presented an illustrated report on the laboratory location, which is now in press as a publication of the Institution.

E. W. OLIVE, Crawfordsville, Ind. Researches on the cytological relations of the Amœbæ, Acrasieæ, and Myxomycetes. $1,000.

Abstract of Report.—Mr. Olive's work has been carried on in Prof. Strasburger's laboratory in the Botanical Institute at Bonn, Germany. In order to do this work he resigned his position as instructor at Harvard University. His studies include cultures of the Acrasieæ and of the Labyrinthuleæ, which he had brought from America.

Mr. Olive's report shows definite progress in his research, and the prospect of the completion within two months of two papers incorporating a portion of his results.

JANET PERKINS, working at the Royal Botanical Gardens, Berlin, Germany. For preliminary studies on the Philippine flora. $1,900.

Abstract of Report.—Dr. Janet Perkins reports that she was engaged in the proposed investigation from February 20 to October 5, 1903. A catalogue of the Philippine flora was begun, based on various monographs and papers which have appeared in scientific periodicals. This work consumed much time, as literature regarding the Philippines is greatly scattered, and the synonymy needs a thorough clearing up.

Among other matters that were begun were: (a) A catalogue of the various native names, (b) a list of botanical literature pertaining to the Philippines, (c) the attempt to construct a type herbarium of Philippine plants, (d) the determination of certain Philippine plants received from the Department of Agriculture, and (e) the preparation of a sample copy of the manuscript and illustrations for the position of the family Marantaceæ.

CHEMISTRY.

W. D. BANCROFT, Cornell University, Ithaca, N. Y. For a systematic chemical study of alloys, beginning with the bronzes and brasses. $500.

Abstract of Report.—The experimental work under this grant has been done by Mr. E. S. Shepherd, under the direction of Prof. Bancroft. They have analyzed the different solid bases and determined the copper-tin-lead diagram except for the alloys containing less than twenty per cent of copper. They have determined the densities and electromotive forces of the annealed bronze, and made a careful microscopic study of the same alloys. Work is now under way on the density and determination of bronzes cast *in vacuo*, the copper-tin-lead diagram, and the making of the necessary analyses. A study of the physical properties of bronzes will be carried on during the winter.

L. M. DENNIS, Cornell University, Ithaca, N. Y. For investigation of the rare earths. $1,000.

Prof. Dennis has been engaged for the past ten years in the study of rare earths, and has accumulated a large amount of purified material. He proposed to carry on a study with special reference to improvements in the methods for determining the atomic masses of these substances, and for separating the elements of the yttrium group.

Abstract of Report.—The work under this grant was carried on by Dr. Benton Dales in the laboratory of Prof. Dennis, of Cornell University. Dr. Dales has submitted a report on the ammonium carbonate and acetic acid method of fractionation. The source of the rare earths used in the work was xenotine, essentially a phosphate of the yttrium group of earths from Brazil. The work is unfinished, owing to Dr. Dales having resigned his position at Cornell University before completing it. Three-fourths of the grant was used. A paper containing the results of the investigation, as far as obtained, was transmitted for publication.

H. C. JONES, Johns Hopkins University, Baltimore, Md. For investigations in physical chemistry. $1,000.

Abstract of Report.—Under the direction of Prof. Jones, Dr. F. H. Gatman began work October 1, 1903, by investigating certain apparently abnormal phenomena manifested by concentrated solutions of electrolytes in water and other solvents. They expect to be able to report considerable progress by the end of the year.

H. N. MORSE, Johns Hopkins University, Baltimore, Md. For researches on osmotic pressure. $1,500.

Abstract of Report.—Prof. Morse reports that the immediate problem to be solved was the development of a practical method for measuring osmotic pressure. Although osmotic pressure has been recognized for twenty-five years as one of the great forces of nature, there have been no direct measurements to furnish an adequate experimental basis for the laws supposed to govern it. Prof. Morse has been engaged for several years in attempting to overcome the difficulties which lie in the way of quantitative measurements of osmotic pressure. He states the problem under three heads, as follows: (1) The preparation of a suitable semipermeable membrane, (2) the overcoming of the mechanical difficulties in assembling the different parts essential to the complete osmotic cell, and (3) the production of an efficient porous wall on which to deposit the semipermeable membrane.

Prof. Morse has succeeded in solving the problems designated by (1) and (2), and the work since October, 1902, has been prosecuted by him and Mr. J. C. W. Fraser, working in the laboratory of the Johns Hopkins University. They have found it necessary not only to work out theoretically, but also practically, the problem of the production of a suitable porous wall, necessitating the molding of the clay under great

pressure in order to give the cell wall a higher and more uniform degree of compactness than is secured by the usual methods of the potter, and to remove thoroughly the air blisters and cavities which render most porous walls unfit for experimental work in osmotic pressure. Their attention was, therefore, turned, in the second place, to the devising of apparatus for the forming of the clay vessels under pressure, with the result that they now possess two pieces of apparatus which work to entire satisfaction. They next proceeded to take up the problem of baking the clay vessels, and devised an electric kiln which was effective and well adapted to general use in the laboratory. They are now ready to begin the making, baking, and burning of porous cells.

A. A. NOYES, Massachusetts Institute of Technology, Boston, Mass. For certain chemical investigations. $2,000.

Abstract of Report.—The work under the direction of Prof. Noyes, on the electric conductivity of salts and aqueous solutions at high temperatures, has been in progress for several months, with the assistance of Dr. William D. Coolidge. Much of the time has been given to the construction of an effective platinum-lined conductivity cell or bomb, suitable for exact conductivity measurements with aqueous solutions up to 306 deg. or higher, and in other preparatory work.

Now that the serious difficulties in the production of the conductivity apparatus, suitable for measurements at high temperatures and pressures, have been overcome, and the possibility of obtaining accurate results has been demonstrated by a series of determinations extending with a few salts up to 306 deg., it is highly desirable to extend the measurements to salts of other types and to acids and bases, and to the critical temperature of 360 deg. This work is very difficult and it will be necessary to continue it for a number of years before it will be completed.

Two other researches for which the aid granted was employed were begun in September with the assistance of Dr. Herman C. Cooper and Yogoro Kato.

THEO. W. RICHARDS, Harvard University. For investigation of values of atomic weights, etc. $2,500.

Abstract of Report.—Prof. Richards has submitted a memoir about to be published by the Carnegie Institution, containing the records of his experiments on a new method of determining compressibility. By means of this method the compressibility of bromine, iodine, chloroform, bromoform, carbon tetrachloride, phosphorus, water and glass have been determined over a range of 700 atmospheres.

Besides the continuation of the preceding work, several other investigations are in progress, assisted by this grant. One of these concerns the effect of pressure on the electrochemical solution tension of metals; another concerns the heat capacity of solutions and another the atomic weight of sodium.

J. BISHOP TINGLE, Illinois College, Jacksonville, Ill. For continuing investigations on the derivatives of camphor and allied bodies. $500.

Abstract of Report.—The work under this grant was not begun till late in the summer. A number of bases have been tested as to their power to undergo condensation with camphoroxalic acid and its ethylic salt. Experiments have also been made to obtain further information as to the possible presence of hydroxyl groups in camphoroxalic acid, with encouraging results. (To be continued.)

THE PARIS AUTOMOBILE SHOW.*

By the Paris Correspondent of the SCIENTIFIC AMERICAN.

THE sixth annual Automobile Show, held in Paris from the 10th to the 25th of last December, was no doubt the largest exhibition of the kind which has ever been held in Europe. The main floor of the Grand Palais was devoted to the stands of the different automobile firms, most of whom exhibited their new 1904 machines for the first time. The exhibits, as a whole, showed general progress in the perfection of details, and only here and there was to be found a real novelty in electric or mechanical methods. Some of the latter are of great interest as showing the direction in which improvement may be looked for in the future. A fine collection of automobile boats shows that the application of automobile motors to launches has made great progress during the past year. The basement was devoted to stationary gas and gasoline engines, of which there were a great variety, most of them being of the well-known types. A few of the leading features of the show will be mentioned at present, leaving a more detailed description for a succeeding article.

DELAHAYE TOURING CAR AND LAUNCH MOTOR.

The chassis of the new Delahaye automobile is shown in one of the engravings, and represents the latest progress in the automobile line. The four-cylinder motor will develop 24 horse power and runs at 1,100 R. P. M. One of the improvements of the 1904 type is the new form of carbureter, the details of which have not as yet been made public. In front will be observed the compact method of mounting the governor, water pump, and ignition contact-box. The first two are driven from a gear which is mounted on the end of the main cam shaft of the motor, while the ignition box is fixed on the end of the same shaft. The governor acts upon the carbureter by means of a lever and spring, and regulates the gas inlet to the motor by means of a valve. The carbureter is placed at the side between the two pairs of cylinders. The regulating action has been well designed. As soon as the flywheel clutch is thrown out, the speed of the motor rises and the governor balls fly apart. This action operates the lever and cuts down the gas inlet to the motor. Another novelty of the Delahaye automobile is a new gear-changing box with a double sliding gear.

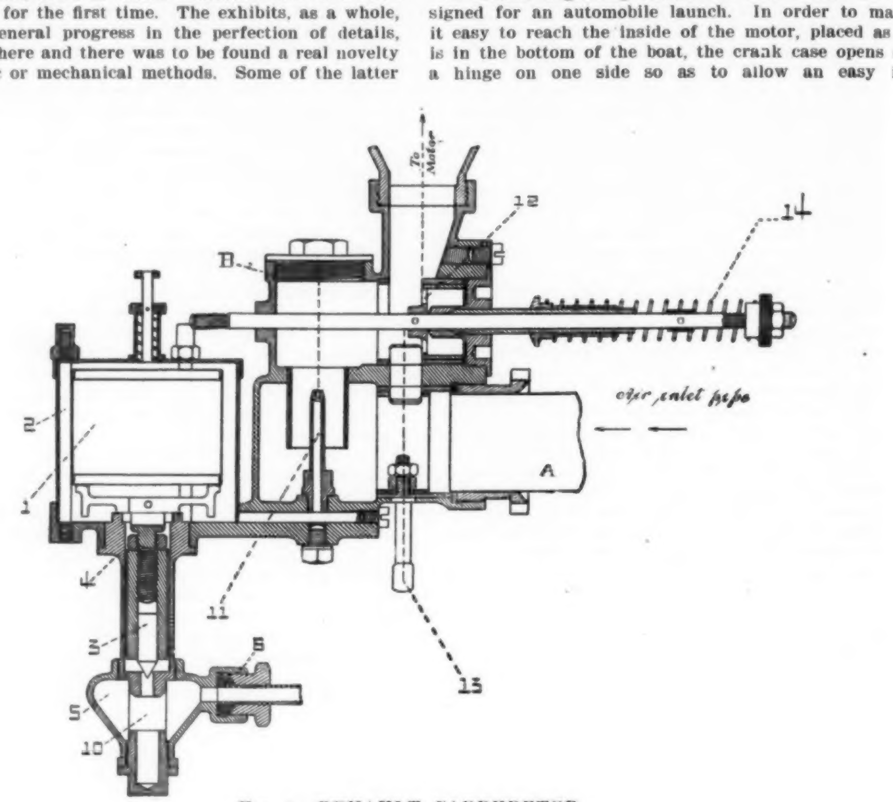


FIG. 1.—RENAULT CARBURETER.

A second engraving shows the new motor as designed for an automobile launch. In order to make it easy to reach the inside of the motor, placed as it is in the bottom of the boat, the crank case opens on a hinge on one side so as to allow an easy inspection of the inside. The present motor has two cylinders and gives 12 horse power, running at 1,200 to 1,500 revolutions. The pump is now placed below the motor and a different form of carbureter is used. The gas inlet is varied by the governor or by hand regulation. A novel method of transmission from the motor to the main shaft is employed. The cone clutch is combined with the differential in such a way that by tightening a band brake upon the differential, the auxiliary bevel gears of the latter are blocked and the shaft is turned in the reverse direction.

FOUILLARON EXPANSIBLE-PULLEY TOURING CAR.

The Fouillaron automobile uses a pair of expansible pulleys to transmit the movement from the motor to the rear, and thus dispenses with the change-gear box. The two expansible pulleys are connected by a leather belt of special construction. The pulleys are formed of two conical wheels, the spokes of which fit into each other like the interlocked fingers of a pair of hands, thus forming a pulley of triangular section. One of the halves is movable, and, by sliding it back and forth, the diameter of the pulley can be varied at will. The same lever shifts both pulleys, making one larger and the other smaller, and *vice versa*, thus keeping the belt length the same. In this way the speed of the car can be easily and quickly varied without the friction loss which is found in ordinary gearing, and instead of the three or four speeds which are obtained in the usual transmission, the speed can be varied gradually and without shocks within the desired limits.

* For illustrations mentioned in this article, see the current number of the SCIENTIFIC AMERICAN.

FIG. 2.—RENAULT TRANSMISSION WITH COVER REMOVED.

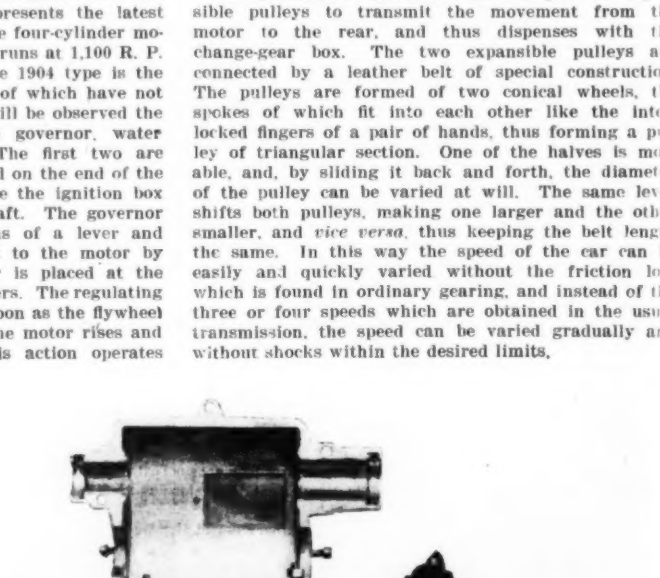


FIG. 3.—SIDE VIEW OF RENAULT TRANSMISSION, SHOWING NEW CONTROLLING ARRANGEMENT AND UNIVERSAL JOINT OF DRIVING SHAFT ON RIGHT.

In the new model of the Fouillaron car the expanding pulleys are placed transversely on the chassis, one of them being on the motor shaft and the other being connected through a universally-jointed driving shaft with bevel gear drive on the live rear axle.

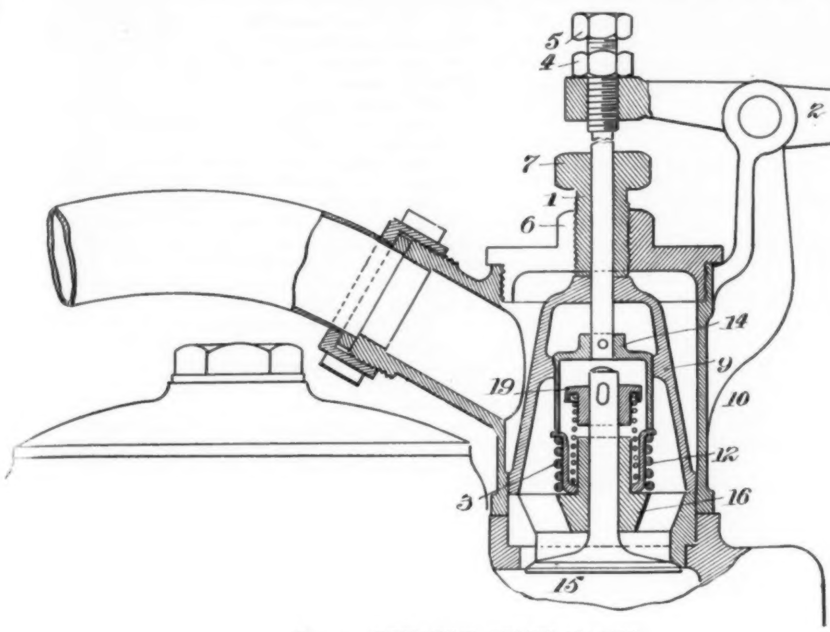


FIG. 4.—RENAULT INLET VALVE.

FIAT MOTOR FOR SUBMARINE BOATS.

One of the novelties which attracted considerable attention was the large 150-horsepower gasoline motor which is intended to be used on a submarine boat in the Italian navy. It is built by the Fiat Company, which is the leading automobile firm of Italy. The motor was ordered by the Minister of War for use on one of the new submarines, as experiments are now being carried on in this direction. The motor is of the four-cylinder pattern and makes 600 revolutions per minute. The cylinder bore is about 12 inches. As it is difficult to start such a large motor, recourse is had to a dynamite cartridge, which gives the desired explosive force for starting. The cartridge is placed in a socket adapted for the purpose at the top of one of the cylinders, and is fired by operating a lever. Before making the explosion, the compression is relieved by a lever in the rear. A magneto (noticed in front) is used to give the ignition spark, and one of the peculiarities of the present motor is that the moment of ignition can be varied; as the magneto is driven by special gearing on the main cam shaft. The gear is mounted so as to be displaced upon the shaft by the action of the governor balls, and in this way the relative position of the armature to the motor stroke is varied according to the motor speed. The second cam shaft in the rear carries a ball governor, which acts upon the inlet of gas to the motor.

THE RENAULT LIGHT CARS.

Among the most successful of last year's racers must certainly be counted the Renault car, which made such a brilliant record in the Paris-Madrid race, coming in first in the light-car class and second in the general classification. This car is built either as a light car or as a voiturette, using a four-cylinder and a two-cylinder motor respectively; otherwise the general disposition of the parts is about the same in each. The designs of the motor, the gear-box, and differential remain about the same as in last year's type, but a number of important changes have been made as regards the minor parts, and these have contributed not a little to the success of the racing car. The present description relates to the light car using the four-cylinder motor.

The type of carbureter which is used on the new Renault machine is shown in the diagram, Fig. 1. It is of the float-feed, atomizer type, but contains some novel features which have made it very successful. With the carbureter is combined a revolving valve for regulating the air-admission for the explosive mixture, and also a second valve for admitting a greater or less quantity of the mixture to the motor cylinders. The constant-level feeding device consists of a hollow cylindrical float, formed of sheet copper (1 in the diagram), contained in the outer chamber, 2, which holds the gasoline. The float rests upon the outer ends of a pair of levers, which are pivoted in the center to a vertical cylinder that moves up and down in a tube below the float. When the float bears upon the levers, it causes the cylindrical shaft to rise, but when it is lifted off the levers, the weight of the cylinder causes it to drop. At the end of the cylinder is fitted a conical piece, 3, which acts as a needle valve to open or close the gasoline opening below. When the gasoline arrives in sufficient quantity (through the lower tube 6) to make the float rise, the needle valve is closed by the weight of the cylinder. As the gasoline is consumed in the motor, the float falls until it comes to bear upon the levers and thus re-opens the valve, so as to let in a fresh supply.

Under the valve is disposed the conical chamber, 5. It carries a screw plug, 6, on the right, which serves to attach the pipe connecting with the gasoline tank. At the bottom of the chamber is placed a screw-cap, 7, so that by unscrewing it the chamber can be cleaned out easily. This part of the carbureter serves for the deposit of any impurities or sediment which the gasoline might contain. A wire-gauze screen, 10, serves to strain the liquid before it goes to the float chamber.

The gasoline passes from the float reservoir to the body of the carbureter which contains the atomizer, 11, the piston valve, 12, for varying the admission of gas to the motor, and the revolving valve, 13, which adds a fresh supply of air to the explosive mixture. The suction of the motor through the tube, *C*, causes the gasoline coming from the float-chamber to form a spray at the atomizer nozzle, as usual, and air is also drawn in from the outside through the air-inlet tube *A*. The mixture of gasoline vapor and air then passes above the atomizer to the upper chamber, *B*. In the Renault carbureter this chamber communicates with the motor inlet tube, *C*, through the medium of a revolving valve, 12, which has a set of openings at the top and bottom. The top opening controls the supply of explosive mixture to the motor, while the lower opening communicates with the air-inlet tube, *A*, and allows an additional quantity of air to be added to the mixture, so as to vary the carburetion. The cylinder is revolved by means of the shaft, 14, which is operated by the governor of the motor. A spring, noticed on the right-hand end of the rod, serves to keep the valve opened to the maximum point; and under the action of the governor it is closed more or less, according to the needs of the motor. The driver can also act upon this valve by a pedal known as the "accelerator pedal," which opens the valve and increases the speed of the motor.

The circular valve, 13, which is mounted in the air-inlet tube, serves to regulate the quantity of air sent into the upper chamber, *B*. It is turned about by a short lever which is connected by a rod with a hand lever just under the main steering wheel of the vehicle. By operating this lever, the final proportion of gasoline and air can be varied.

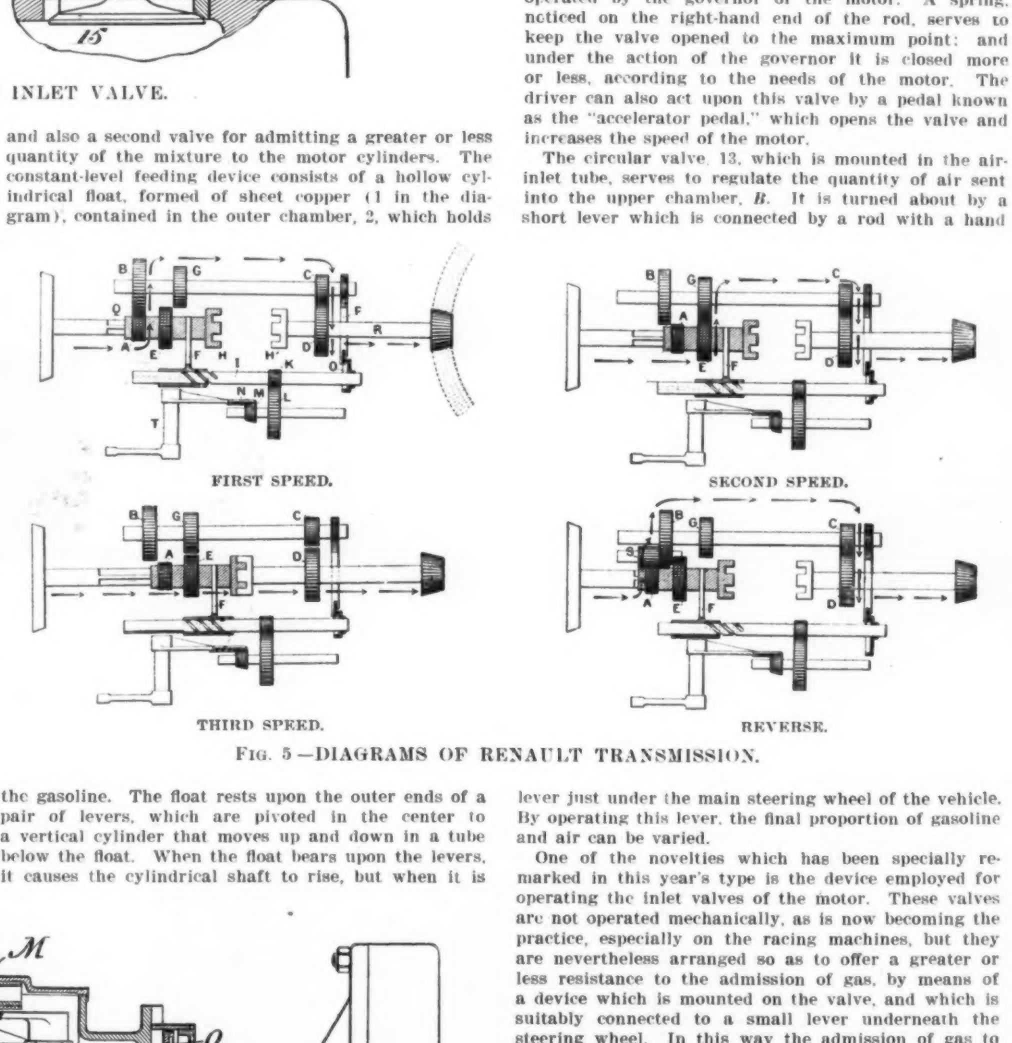


FIG. 5.—DIAGRAMS OF RENAULT TRANSMISSION.

One of the novelties which has been specially remarked in this year's type is the device employed for operating the inlet valves of the motor. These valves are not operated mechanically, as is now becoming the practice, especially on the racing machines, but they are nevertheless arranged so as to offer a greater or less resistance to the admission of gas, by means of a device which is mounted on the valve, and which is suitably connected to a small lever underneath the steering wheel. In this way the admission of gas to the motor is varied without using a throttling valve on the inlet pipe.

The device which has been adopted is shown in the section (Fig. 4) representing the cylinder head, the gas inlet pipe, and one of the valves. Each of the four admission valves of the motor has the same mechanism. The valve is provided with two springs, one light and one heavy, which work against each other. The inner or small spring, 10, is the usual spring which forms part of the valve mechanism and serves to keep the valve held up against its seat. The valve, 15, is guided by its rod which moves up and down in the fixed guide-piece, 16. The small spring bears up against the stop-piece, 19, which is mounted on the upper end of the rod. At the lower end the small spring does not bear directly upon the support, 16, as is ordinarily the case, but against the bottom of a thimble, 12, which surrounds the valve rod. (The figure shows the thimble lying against the support, but it is usually separated from it.) The thimble in turn is supported upon the large spring, 3, whose action tends to oppose that of the small spring, as will be observed from the fact that the large spring bears below upon the fixed support and tends to lift the thimble containing the small spring. If the thimble were not pressed down by the cap, 14, carried on the

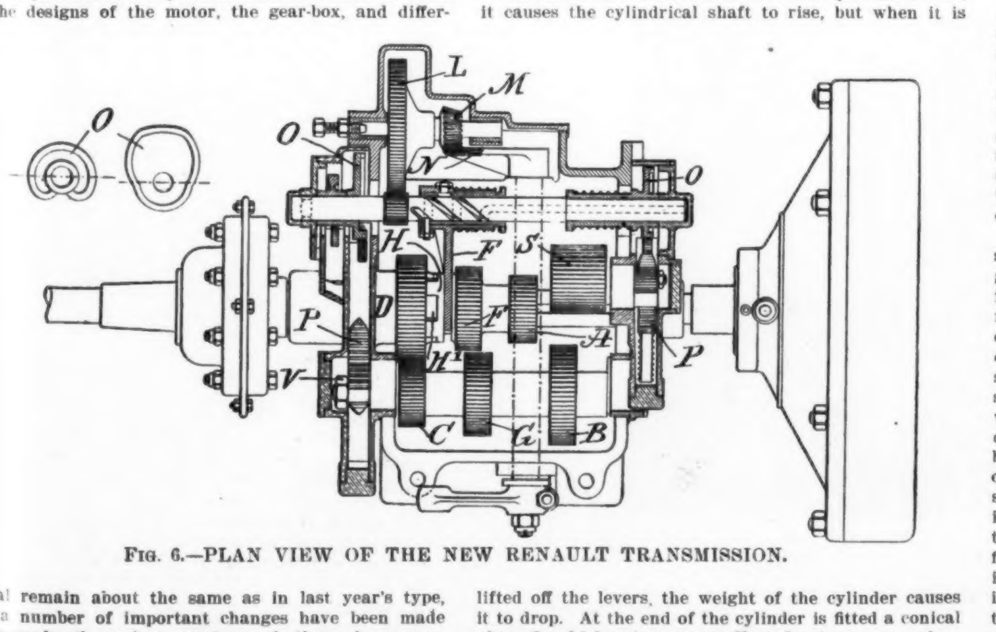


FIG. 6.—PLAN VIEW OF THE NEW RENAULT TRANSMISSION.

main rod, 1, the large spring would compress the smaller one completely and thus block the valve upon its seat.

In order to vary the action of the valve, it suffices to push down the rod, 1, to a greater or less degree. By so doing, the cap, 14, will compress the large spring more or less, and thus take its action off the small spring, setting it free and allowing the valve to operate. If, as shown in the figure, the rod is pushed completely down so as to bring the thimble against the fixed support, 16, the effect of the heavy spring will be entirely suppressed, and the valve will work normally under the action of the light spring. By exerting a greater or less pressure on the large spring, the rate of gas admission to the motor can thus be varied at will from zero (in the position shown) up to the maximum. A hand lever mounted below the steering wheel is suitably connected with the rod, 8. The latter operates the lever, 2, which acts upon the rod, 1, through the set-screw, 5.

The device is protected by the cylindrical brass cap, 6, which also holds the bracket for the lever. This method of regulation has proved quite satisfactory and the motor is easily controlled by means of the hand lever. One advantage to be noted is the comparatively noiseless action of the valve, as the shocks are taken up by the large spring, which acts as a cushion.

The four-cylinder motor is provided with a new system of ignition. As usual, accumulators, induction coils, and spark plugs are used, but the new disposition uses only one-half the number of parts which are generally needed for a four-cylinder motor, and requires but two induction coils in place of four. The revolving cam which distributes the current has but two contacts instead of four. This simplification is based on the possibility of making the ignition in two cylinders at a time.

If we consider the pairs of cylinders 1 and 4, 2 and 3, when in one cylinder of the pair the piston is in the position ready for the ignition, in the other it is at the end of the exhaust stroke. There is therefore no drawback in making the ignition spark in the latter cylinder. This disposition allows of making the spark simultaneously in each pair of cylinders, and thus uses only two induction coils and two contacts at the sparking-cam. The induction coil, in place of having one of its wires grounded on the motor, has the two ends of the secondary coil connected to two insulated binding-posts mounted on the containing box. The two spark plugs of a set are each connected to one of the binding posts. The other points of the spark plugs, being fastened in their shells, of course are in contact with motor. In this way the two plugs are in series on the secondary circuit, and the motor acts as a connection between the two. The spark is thus formed simultaneously in the pair of plugs.

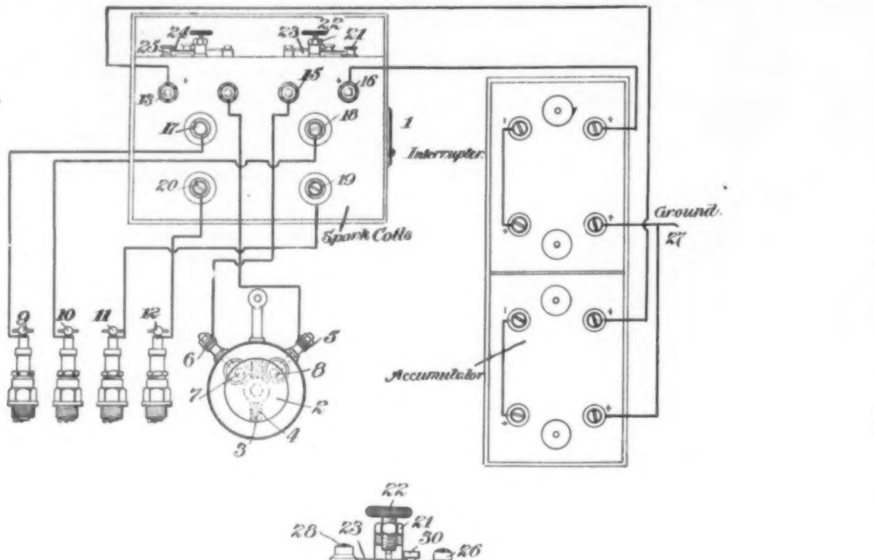


FIG. 7.—ARRANGEMENT OF IGNITION SYSTEM OF THE RENAULT CARS.

The accompanying diagram, Fig. 7, shows the distribution of circuits. To the right are the two batteries of accumulators. In the center is the box containing the two induction coils. The two-way switch, 1, mounted on the side of the box allows of using one or the other of the batteries; the second battery acts as a reserve and is thrown in only when the first is exhausted. Each battery contains two cells which are mounted together in a sheet-metal case. At the top of the induction coil box will be observed the two vibrators, 22 and 24. One of these is seen in detail underneath. In the center is the revolving contact-cam which is driven from the motor shaft. It makes the contacts for the two pairs of cylinders. The cam carries a metal strip, 4, which is in electrical contact with the motor. Bearing on the cam are two small insulated brushes, 7 and 8, which are pressed against it by springs. The brushes are fastened to the binding posts, 5 and 6. Each of the binding posts is connected with one of the ignition circuits.

The Renault chassis for 1904, which have been lengthened to accommodate the new style bodies, are of three different types. These consist of a 7, 10, and 14 horse power chassis. The 10 and 14 horse power chassis are fitted with motors like those used on the shorter chassis of the 1903 model, while the 7-horse-power chassis is fitted with a new motor having several improvements. These three types of longer chassis have a perfected transmission, of which the following is a description:

The Renault transmission (Figs. 2, 5, and 6) consists of two parallel shafts. The main shaft, which is in line with the motor crank shaft, is in two parts, one of which is squared, has two sliding gears, *A* and *E*, mounted upon it, and terminates in a miter gear, *H*; while the other carries a similar miter gear, *H'*, and a spur gear, *D*, within the gear case, with the bevel driving pinion on the outside.

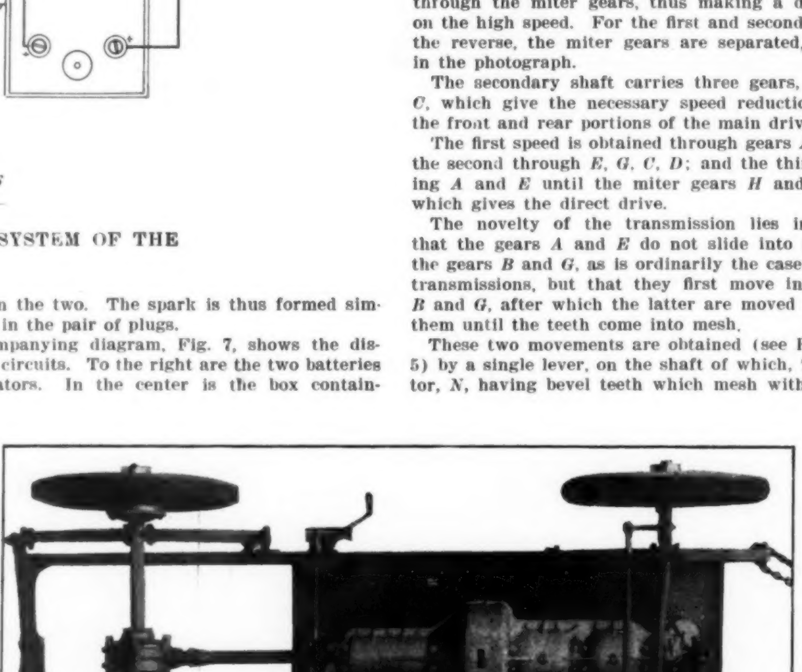
The two parts of this main shaft can be joined through the miter gears, thus making a direct drive on the high speed. For the first and second speed and the reverse, the miter gears are separated, as shown in the photograph.

The secondary shaft carries three gears, *B*, *G*, and *C*, which give the necessary speed reduction between the front and rear portions of the main driving shaft.

The first speed is obtained through gears *A*, *B*, *C*, *D*; the second through *E*, *G*, *C*, *D*; and the third, by sliding *A* and *E* until the miter gears *H* and *H'* mesh, which gives the direct drive.

The novelty of the transmission lies in the fact that the gears *A* and *E* do not slide into mesh with the gears *B* and *G*, as is ordinarily the case in similar transmissions, but that they first move in line with *B* and *G*, after which the latter are moved up against them until the teeth come into mesh.

These two movements are obtained (see Figs. 3 and 5) by a single lever, on the shaft of which, *T*, is a sector, *N*, having bevel teeth which mesh with the bevel pinion, *M*, on the same shaft with a gear, *L*. This gear meshes with a pinion, *K*, on the operating shaft, *I*, which has, near one end, a spiral groove, and near the other a cam, *O*, which moves the rack, *P*. The fork, *F*, which slides the gears, is mounted on a sleeve. A pin projects from this sleeve into the spiral groove, and, as the shaft *I* is rotated, it necessarily follows the groove and moves the sleeve in one direction or the other, according to the direction of rotation of *I*. In this manner, the gears are shifted, while the cam, *O*, acting on the rack, *P*, and its pinion, causes the eccentric bearings of the secondary shaft to rotate in either direction sufficiently to move this shaft away from or toward the main shaft until the gears are out of or in mesh. To produce the reverse, an intermediate pinion, *S*, is brought into mesh with gears *A* and *B*, as shown in the diagram, Fig. 5.



LOWER SIDE OF DECAUVILLE CHASSIS, SHOWING ARRANGEMENT OF MOTOR AND TRANSMISSION GEAR ON APRON.

The rotation of the shaft, *I*, which was formerly accomplished by a toothed sector placed outside of the transmission gear case, and in a special mandolin-shaped case, is accomplished in the new model, herewith illustrated, by the bevel-toothed sector, *N*, placed in the interior of the gear case proper, and meshing with the bevel pinion, *M*. (See Fig. 3.)

The operation of the change speed lever is made easier by this arrangement of the parts; and, moreover, the placing of the transmission gear and its operating mechanism in a single case presents numerous advantages from the point of view of assembling and disassembling their various parts, as well as for the quick and easy inspection of the same.

IMPROVED FRAME CONSTRUCTION ON THE DECAUVILLE CAR.

A method of automobile construction which has been adopted by the Decauville Company, of Paris, is likely to prove of great practical value on account of the different advantages it possesses in the way of simplicity as well as solidity. Shocks can be stood much better by the motor and mechanism with the new construction, which applies to the method of forming the protecting casing of the mechanism and of mounting it upon the chassis. The main feature of the new construction

THE FOUILLARON CHASSIS.

the use of a single casting to form the lower half of the crank case and gear-changing box. In most automobiles the motor is mechanically separated from the gear box, and under the shocks of the road each of these parts, which are the heaviest on the car, is likely to take a different movement and in this way cause an unequal strain on the mechanism. In the present construction this difficulty is overcome by building the motor crank case and the gear box in a solid piece, so as to avoid any displacement between them.

In the illustration, which shows the under side of the new Decauville chassis, will be noticed the disposition which has been adopted, and which seems to be one of the most striking improvements in recent automobile practice. The bed-casting above mentioned, which forms the lower half of the crank case and gear-box, is mounted in the center of a large pressed steel plate which supports it on the chassis. The casting fits into an opening cut out of the plate, and is solidly held down by bolts passing through the flange. Aluminium is used for the casting. This has a pair of depressions in front for the cranks of the motors. The large semi-cylindrical depression next to these serves for the flywheel and friction clutch, which are mounted together. The rear part forms the lower half of the gear box.

This arrangement gives an absolute rigidity in the transmission of the power to the rear, no matter what may be the jarring of the chassis when subject to the shocks of the road. In this way all sticking of the bearings is avoided, and it is well known that the sticking, even though slight, absorbs a large part of the energy which is transmitted by the motor to the rear wheels, owing to the high speed at which the shaft revolves. The universally-jointed shaft which connects the transmission with the differential mounted on the rear axle is outside the gear box.

Another new feature of the Decauville car which seems highly practical is the use of the large stamped steel plate which serves as a support for the above outfit. The plate is riveted to the channel-bars which form the frame of the chassis. It has a small rectangular opening for the shaft of the steering wheel, which passes through it. The increased solidity obtained by the use of the large plate instead of cross-bars to support the mechanism is at once obvious. The trials which have been made at Paris with the new system show that it bears out all that is claimed for it, and it may be ranked among the leading improvements in this line.

THE DARRACQ PRESSED STEEL FRAME.

The Darracq Company have gone one step further, and have brought out a complete pressed steel frame like the Decauville but having the "apron" that holds the engine and transmission integral with the frame instead of riveted to it. The Darracq frame was one of the features of the show, and it is a good example of the possibilities of pressed or stamped steel construction.

ELECTRICAL VISION.

THE various methods which have been proposed from time to time for transmitting sight electrically have been studied by M. A. Nisco, but they seem to him to lack certain necessary features. He has therefore devised the following system, which he believes to be practical. A sensitive screen is prepared by coating a metallic net with some insulating gum. Into the meshes of this net copper wires are inserted before the insulation hardens. After drying, the surface is dressed off with a file, and is then coated with selenium, thus forming a sensitive connection between the wires and the net. The screen prepared in this way is treated to crystallize the selenium, so as to bring it into the proper sensitive condition. The copper wires which terminate in the screen are then led into an ebonite cylinder, and pass out through holes corresponding in position to their termination in the sensitive screen. These holes are arranged in spirals in such a way that a metallic blade which revolves around the cylinder successively makes contact with every terminal. The blade is revolved about the cylinder at a speed of 600 revolutions per minute, so that every contact is repeated ten times a second. From the blade and from the wire net of the sensitive screen, wires are led through a battery and to a telephone receiver. If a picture be thrown upon the sensitive screen, and the blade be revolved about the cylinder, a varying current will be sent through the telephone, the intensity of which will vary with each contact, according to the intensity of the light falling upon the corresponding section of the screen. This telephone by means of a sensitive carbon microphone, repeats through the transmission line the current variations produced by the apparatus just described. At the receiving station a second telephone repeats the variations in current through a second microphone in a local circuit arranged to produce a spark. The intensity of the spark at any instant corresponds to the intensity of illumination of a particular part of the selenium screen. This spark-gap is placed within a cylinder having spiral slots, and the slotted cylinder revolves in synchronism with the contact blade at the transmitting station. This arrangement throws the light of each spark on such a part of a receiving screen so as to produce an illuminated image similar to that thrown on the sensitive receiving screen. The method can only produce variations in illumination. It requires two wires, one for synchronizing the moving parts, and one for transmitting the varying current.—Electro.

TRADE SUGGESTIONS FROM UNITED STATES CONSULS.

Orange Boxes for Paraguay.—I submit, for the information of the Department of Commerce and Labor, an account of the active interest that is being displayed by the orange growers of this country for the development of the orange business and the cultivation of the trees. I do not think that with the present system of exporting oranges they will ever be able to send them to North American or European markets; still, there is an enormous exportation to the countries south of Paraguay.

With a view to changing the methods of exportation, a number of the growers have spoken to me of the systems employed in the United States, especially in the State of California. They would be glad to obtain catalogues of orange-box manufacturers, with prices of boxes already made, but knocked down f. o. b. New York, or, better still, f. o. b. Buenos Ayres. At the same time, they would be glad to get such information as these box manufacturers or such other parties engaged in the fruit-packing business could give them that would assist in improving this branch of trade in Paraquay. I believe that if the boxes, which necessarily have to be of very light wood, could be obtained at a reasonable price large quantities would be purchased. Although there exists in this country a great amount of timber, it is principally hard wood.

In addition to the boxes, they would be glad to get some catalogues and information on classifiers or machines for separating the oranges preparatory to boxing.

The Paraguayan orange is one of the best on the market in Buenos Ayres and Montevedio, particularly those which are grown in the higher portions of the country, called the cordilleras, famous for their superior quality, sweetness, and flavor.

The system of exporting oranges now is very crude and contributes more to the destruction of the fruit than to its preservation. They are hauled for miles in carts, in which they are loaded in heaps, to the point of embarkation on the river. There they are piled up on the steamboats, whither they are carried in baskets on the heads of women.

In spite of this crude way of exportation, there is a very large business done annually. If the improved boxing and packing methods of the United States could be adopted here, as I believe it will be, the trade would advance, whereas now thousands of oranges rot on the ground.

In this country the oranges seem to have no pest enemies except the locusts, which visit Paraguay about every seven to ten years, so I am informed.

Parties interested in this matter will kindly send to this consulate any information pertaining to the orange business.—John N. Ruffin, Consul at Asuncion, Paraguay.

Brazilian Imports.—Das Handels Museum of August 6, 1903, says:

"Brazil imports pig iron from Belgium and Great Britain, cast-iron sewage pipes from Belgium, galvanized water pipes from Germany, rails from France, while iron bridges, which the government uses in road building, come mainly from Germany. The steam engines used on the coffee plantations come mostly from Great Britain. In imports of unmanufactured iron and industrial articles, such as iron rails, Germany leads. The better qualities of hoes come now from Great Britain, and the better grades of axes are imported from the United States. Shovels and spades come partly from Germany, but mostly from Great Britain; hammers and tongs, from Germany; the cheaper grades of wood knives from Great Britain, while the better qualities are imported from Germany. Zinc and soldered sheet-iron buckets come from Great Britain; enameled iron utensils and sheet-iron wash basins, from Germany; while metallic and enameled plates and galvanized kitchen utensils are imported from Great Britain. Enameled cast-iron pots come from Germany. All kinds of iron house fixtures were formerly imported from the United States, but now come from Germany. Bolts and nails come from France. Formerly barbed wire was imported from Germany, but now comes mostly from the United States, Great Britain, and Belgium. Wire nails are no longer imported, but are manufactured in the country. Tinware is imported from Great Britain; iron wheelbarrows from the United States, while plows are partly German, but mainly of American manufacture."

Russian Commercial Museums in Persia.—The following is a translation made in the Bureau of Statistics, Department of Commerce and Labor, from the Revue du Commerce Extérieur, September 19, 1903:

"The principal bureau of the Russian Company for Navigation and Commerce has just addressed a special circular to all large firms in the Empire, urging them to aid in the establishment of direct shipping facilities between Odessa and ports on the Oman Sea and Persian Gulf. A service of this kind would result in the planting of the Russian flag in those distant parts, where up to the present hardly any but English ships have visited; in opening new markets for Russian products; and in the bringing together of Russian exporters and Persian consumers, among whom England, in the absence of active competition, has acquired considerable influence. The Russian company has been working along these lines for ten years and is encouraged to believe that the proper organization of Russian industries will result in Russian goods soon dividing the trade with English goods. In view of these considerations, the imperial government, according to the Moniteur Officiel of Odessa, has just arranged with this company to inaugurate this service. The company, thus encouraged, has decided to establish in the more important ports on the Oman Sea and Persian Gulf, particularly at Bassorah, permanent museums of Russian industry, which will be known as 'Russian museums,' and which will show as far as possible all the products exported from Russia. An agent, specially instructed to impart necessary information, will be stationed at each of the museums."

American Wheat Inspection.—There is again complaint at this port with respect to the carelessness of American inspectors, and local millers are hardly in a mood to receive American propositions. I have detailed information respecting one lot of 40,000 tons of red winter No. 2 shipped from one of our Southern ports, receipt of which was refused by the buyers on arrival at Marseilles because the grain did not conform to the certified description given by the inspecting authorities at the port of departure. At auction sale this same wheat brought some 3 cents less than the price at which it had been purchased, and the case is now in the local courts. The principle involved in this matter is the same as that frequently discussed in my reports. European buyers find our American inspection plan admirable in theory but unsatisfactory in practice, for the reason that no guaranty whatever accompanies the certificate. No United States official is authorized to fix crop standards, and inspectors have varying ideas respecting an undetermined standard by which they undertake to grade grain coming before them.—Robert P. Skinner, Consul, Marseilles.

English vs. American Coal.—The question of keeping up a supply for the increasing demand for English coal has become a matter of deep concern for Great Britain's economical circles. A royal commission has been appointed to investigate the subject. A German journal in reviewing the matter, says:

"The difficulties encountered by British coal miners in being obliged to operate 3,000 to 4,000 feet below the surface and the enhanced cost attending deep-level mining will enable the coal exporters of the United States to supplant the English product from foreign markets."

What we require in order to obtain control of the coal trade of the world are transportation lines and new business connections which will secure return freights for our coal ships.—Simon W. Hanauer, Deputy Consul-General, Frankfort, Germany.

Americans and American Trade in Parral.—During the last year there has been invested at least $1,500,000 of American capital in this district, and a large amount of development work has been done; a number of important mining plants have been erected and a few good mines have been developed. I estimate the number of Americans in this district interested in business at 200. There has been a marked increase in imports from the United States during the year. The largest increase has been in mining machinery. Groceries are imported by the carload. A large increase in the imports of American boots and shoes has also taken place during the year, with a fair increase in the imports of dry goods, hardware, and agricultural machinery.—James J. Long, Consular Agent, Parral, Mexico.

American Trade in Aix la Chapelle.—There is more evidence of American goods for sale in the shops of this city at present than at any previous time. Aix la Chapelle is a good market for American manufactures, but could be greatly enlarged if the trade were properly worked. American shoes, cash registers, and sporting goods seem to be established in popular favor and in demand.—Frank M. Brundage, Consul, Aix la Chapelle, Germany.

INDEX TO ADVANCE SHEETS OF CONSULAR REPORTS.

Other Reports can be obtained by applying to the Department of Commerce and Labor, Washington, D. C.

SELECTED FORMULÆ.

Silver Soap.—

Cocoanut-oil soap	8 ounces
Hot water	8 fl. ounces
Prepared chalk	16 ounces

Make a solution of the soap and water and incorporate intimately with the chalk.—Spatula.

Brilliant Polish for Wood.—A polish for pianos, cabinets, etc., is made by dissolving 65 parts of gum mastic and 250 parts of shellac in 1,000 parts of alcohol of 95 deg. To clarify the solution add 10 per cent of its volume of benzin, shake, set aside to separate, then decant. Apply as French polish.—National Druggist.

Kid Glove Cleaner.—

Soft soap	1 ounce
Water	4 ounces
Oil of lemon	½ drachm
Precipitated chalk, a sufficient quantity.	

Dissolve the soap in the water, add the oil and make into a stiff paste with a sufficient quantity of chalk.—Spatula.

To Remove Pyro Stain.—Immerse in a clearing bath as follows:

Protosulphate of iron	3 ounces.
Alum	1 ounce.
Citric acid	1 ounce.
Water	20 ounces.

Prevention is better than cure, however; therefore immerse the negatives in the above directly they are taken from the fixing bath. After clearing the negatives, they should be well washed.—Spatula.

Two Excellent Liquid Blackings.—On the authority of the Corps Gras Industriels we present the following formulæ, which that journal declares to make a product of excellent quality:

1. Ivory black	120 parts.
Brown sugar	90 parts.
Olive oil	15 parts.
Stale beer	500 parts.

Mix the black, sugar, and olive oil into a smooth paste, adding the beer, a little at a time, under constant stirring. Let stand for 24 hours, then put into flasks, lightly stoppered.

2. Ivory black	200 parts.
Molasses	200 parts
Gall nuts, bruised	12 parts.
Iron sulphate	12 parts.
Sulphuric acid	40 parts.
Boiling water	700 parts.

Mix the molasses and ivory black in an earthen vessel. In an iron vessel let the gall nuts infuse in 100 parts of boiling water, for 1 hour, then strain and set aside. In another vessel, dissolve the iron sulphate in another 100 parts of the boiling water. One half of this solution is added at once to the molasses mixture. To the remaining half add the sulphuric acid, and pour the mixture, a little at a time, under constant stirring, into the earthern vessel containing the molasses mixture. The mass will swell up and thicken, but as soon as it commences to subside, add the infusion of gall-nuts, also under vigorous stirring. If a paste blacking is desired the preparation is now complete. For a liquid black add the remaining portion of the boiling water (500 parts), stir thoroughly and bottle.

Some New Inks.—The Augsburger Seifensieder Zeitung gives the following formula:

Alizarin Blue Copying Ink.

In 20 parts of fuming sulphuric acid dissolve 5 parts of indigo, and to the solution add 100 parts of extract of aqueous myrobalous and 10.5 parts iron filings or turning-shavings. Finally add:

Gum arabic	1.5 parts.
Sugar	7.5 parts.
Sulphuric acid, 66 deg. B.	10.5 parts.
Anilin blue	1.5 parts.
Carbolic acid	0.5 part.
Mirobalan extract to make	1,000 parts.

This ink when first used has a bluish tint, afterward becoming black.

Alizarin Green Copying Ink.

In 100 parts of aqueous extract of gall-apples dissolve:

Iron sulphate	30 parts.
Copper sulphate	0.5 part.
Sulphuric acid	2 parts.
Sugar	8 parts.
Wood vinegar, rectified	50 parts.
Indigo carmine	30 parts.

Normal Ink (Class 1).

This ink is made under directions of the Chemico-Technic Imperial Institute at Carlottenburg, and must contain at least 4 grains of metallic iron and 30 grammes of tannin to the liter of ink. The following is its formula:

Tannin	40 parts.
Iron sulphate	22.5 parts.
Copper sulphate	1 part.
Wood vinegar, rectified	30 parts.
Sulphuric acid	3 parts.
Rein-blau II. (anilin blue No. 2)	2.5 parts.

Dissolve in water sufficient to make 1,000 parts.

School Inks.

Extract of gall apples	500 parts.
Iron sulphate	15 parts.
Copper sulphate	0.25 part.
Wood vinegar	25 parts.
Indigo carmine	15 parts.
Water to make	1,000 parts.

Mix and dissolve.

THE

Scientific American Supplement.

PUBLISHED WEEKLY.

Terms of Subscription, $5 a Year.

Sent by mail, postage prepaid, to subscribers in any part of the United States or Canada. Six dollars a year, sent, prepaid, to any foreign country.

All the back numbers of THE SUPPLEMENT, from the commencement, January 1, 1876, can be had. Price, 10 cents each.

All the back volumes of THE SUPPLEMENT can likewise be supplied. Two volumes are issued yearly. Price of each volume, $2.50 stitched in paper, or $3.50 bound in stiff covers.

COMBINED RATES.—One copy of SCIENTIFIC AMERICAN and one copy of SCIENTIFIC AMERICAN SUPPLEMENT, one year, postpaid, $7.00.

A liberal discount to booksellers, news agents and canvassers.

MUNN & CO., Publishers, 361 Broadway, New York.

TABLE OF CONTENTS.

30, 1904.

plement.

y.

a Year.

oscribers in
Six dollars
ntry.
EMENT, from
be had. Pri

EMENT can li
issued year
paper, or $

ENTIFIC Am
AN SUPPLEME

ews agents

way, New York

TS.

duction in the
-10 illustrations
and Alcohol...
States Consuls.

Steam-by Ira-
etts Institute of
stration...
or the Advance-

ons.........

Y

ove-
ANY
ring
ade-
BOOK
e in